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FAO Fisheries Synopsis No. 125, Volume 2

FIR/S125 Vol. 2

# FAO SPECIES CATALOGUE

## VOL. 2 SCOMBRIDS OF THE WORLD

### AN ANNOTATED AND ILLUSTRATED CATALOGUE OF TUNAS, MACKERELS, BONITOS, AND RELATED SPECIES KNOWN TO DATE

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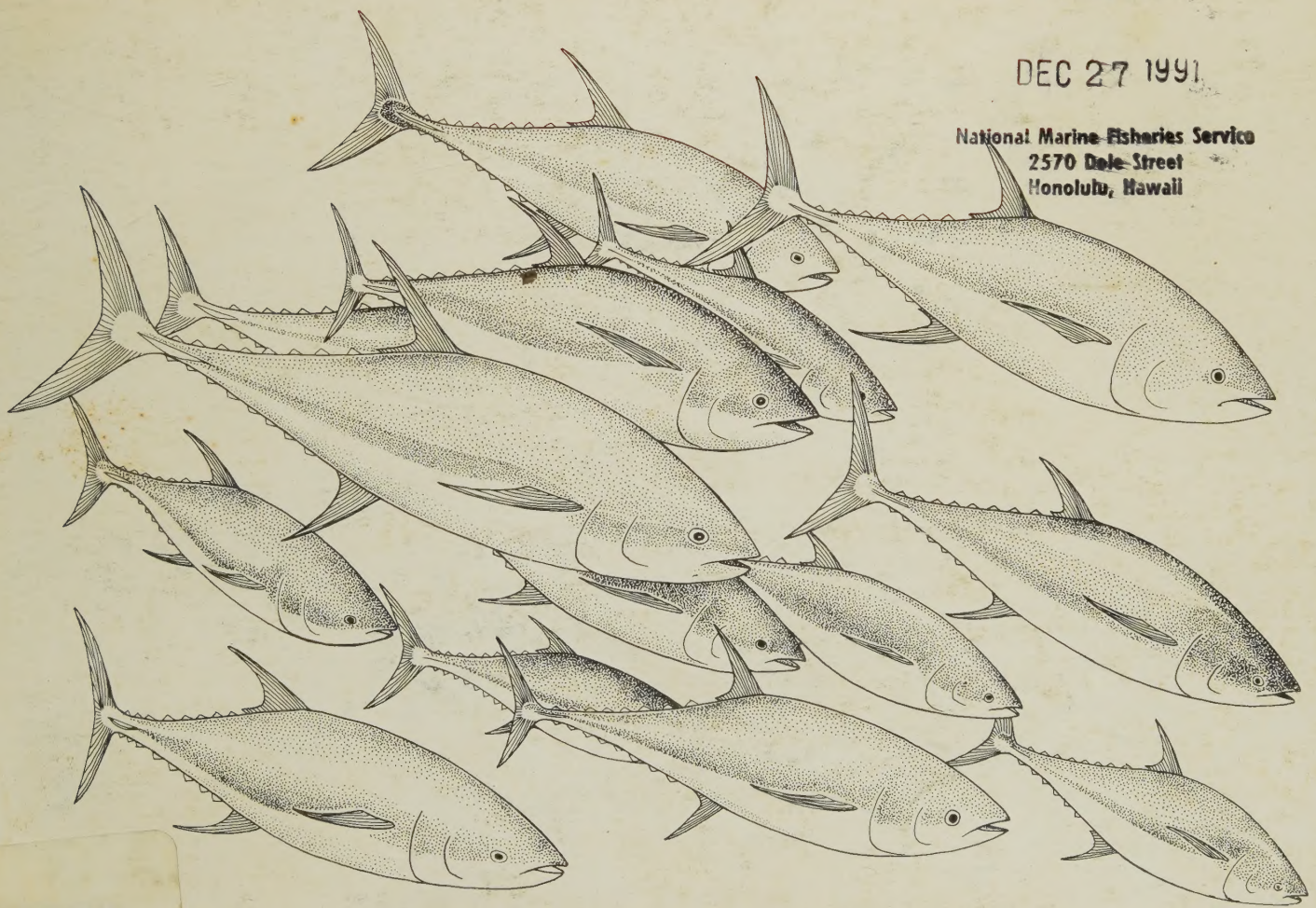

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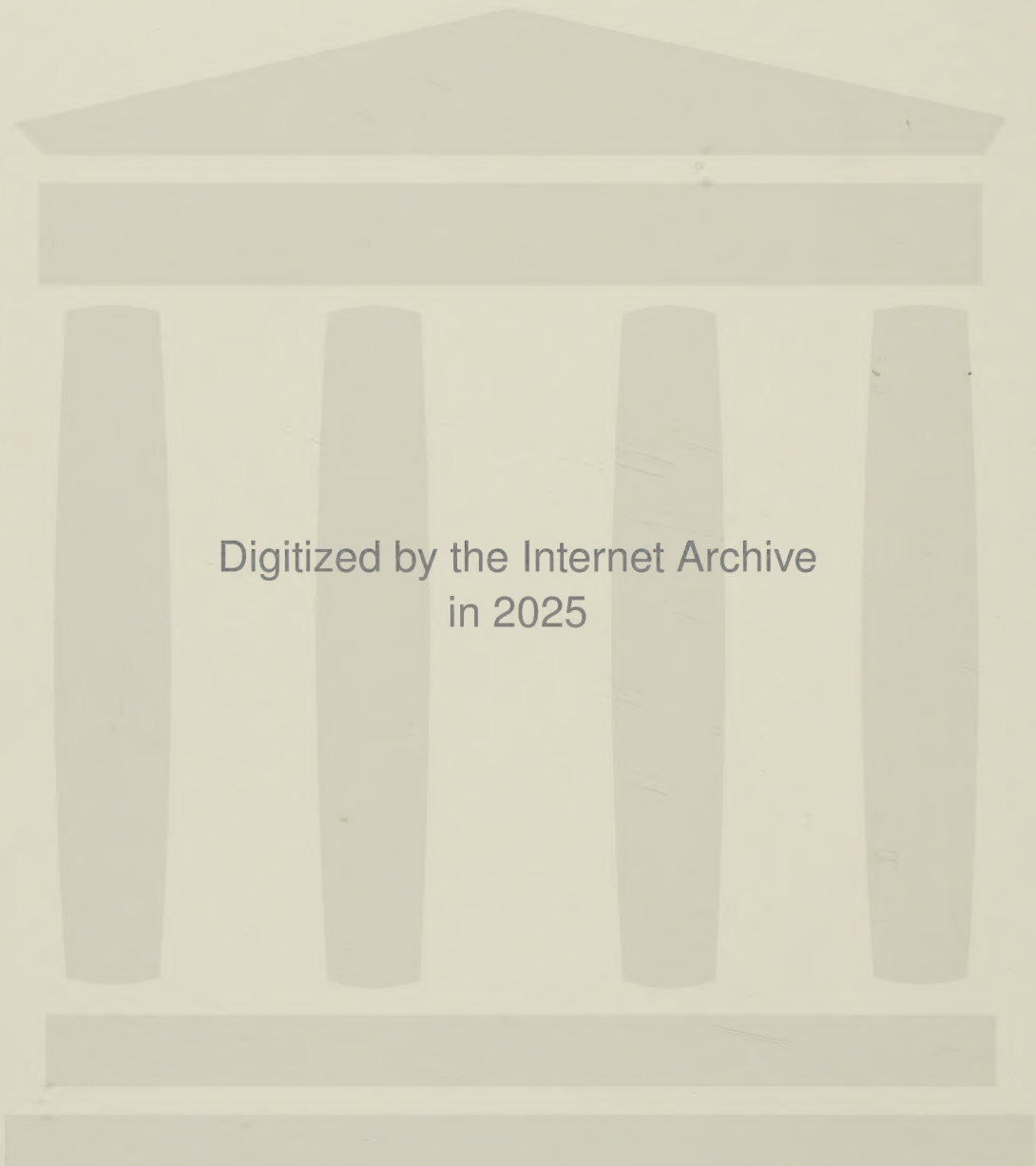

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FAO SPECIES CATALOGUE

# VOL. 2 SCOMBRIDS OF THE WORLD

An Annotated and Illustrated Catalogue of Tunas, Mackerels, Bonitos and Related Species Known to Date

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UNITED NATIONS DEVELOPMENT PROGRAMME

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Rome 1983

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ISBN 92-5-101381-0

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## PREPARATION OF THIS DOCUMENT

The present publication, prepared under the UNDP/FAO Project for the Survey and Identification of World-Marine Fish Resources (GLO/82/001), is the second worldwide species catalogue issued within the FAO Fisheries Synopses series.

From the initial idea of publishing an annotated world list of scombrids the draft evolved during the various stages of elaboration to become an illustrated catalogue encompassing also information on the habitat, biology and fisheries for each species.

The preparation of the document in its final form was carried out at the Marine Resources Service of the FAO Fishery Resources and Environment Division, under the supervision of Dr W. Fischer, editor of the FAO Species Identification Programme.

The indexes of scientific and common international FAO species names and of local species names were prepared in collaboration with FAO's Fishery Information, Data and Statistics Service.


### ABSTRACT

This is the second in a series of species catalogues produced in the framework of a worldwide annotated and illustrated inventory of aquatic food species FAO intends to build up. The present volume covers all 49 species of scombrids known so far. It provides a comprehensive key to genera and species, preceeded by an illustrated glossary of technical terms and measurements. The systematic part of the catalogue includes a drawing and a distribution map for each species, a list of scientific and vernacular species names and wide-ranging information on habitat, biology, and fisheries. Ample reference is made to pertinent literature.



**Distribution :**

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FAO Fisheries Department
FAO Regional Fisheries Officers
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**For bibliographic purposes this document should be quoted as follows :**

Collette, B.B. and C.E. Nauen, 1983. FAO species catalogue. Vol. 2. Scombrids of the world. An annotated and illustrated catalogue of tunas, mackerels, bonitos and related species known to date. FAO Fish.Synop., (125)Vol. 2: 137 p.

## FOREWORD

This publication is the second in a series of worldwide species catalogues produced by FAO. The series was initiated in 1980 with the publication of "Shrimps and Prawns of the World", by L.B. Holthuis, and will be continued, in the near future, with similar catalogues for other groups of major interest to fisheries.

The present catalogue represents FAO's first attempt toward a world-wide annotated and illustrated inventory of all representatives of the family Scombridae. It is aimed primarily at individual workers and institutions concerned with scombrid fisheries. Apart from representing a coded inventory of scientific and standardized vernacular names, it is a source of wide-ranging information by species on basic systematics, geographical distribution, habitat, biology and fisheries. Future updating and expansion of this information is considered essential, and with this in mind, FAO is developing a computerized data base by families and species which will allow easy storage of information and periodic updated outputs.

We strongly encourage users of the catalogue to participate in keeping this document up-to-date, thus rendering it more useful by providing us with new information. All suggestions and additional information should be sent to the editor of the series, Dr W. Fischer. Problems concerning species identifications should be addressed to the senior author.

Further species catalogues currently in preparation under the FAO/ UNDP Project on Survey and Identification of World-Marine Fish Resources include, among others, sharks, cephalopods, billfishes, cods/hakes, snappers, herrings, sardines/anchovies, left-eye flounders and lobsters.

Armin Lindquist
Director
Fishery Resources and Environment Division
Fisheries Department

# SCOMBRIDS OF THE WORLD

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# 1. INTRODUCTION

This catalogue covers all of the 49 scombrid species presently known, irrespective of their current commercial importance. It is based primarily on information from literature, and this has led inevitably to a certain unbalance in the species accounts. In fact, while there is a wealth of information on the economically important mackerels and tunas, the literature available on the less common species of Spanish mackerels is rather scarce. Sometimes it is difficult to evaluate the reliability of published data, particularly in cases where the identity of the species referred to is doubtful. Moreover, the discovery of new species, the more accurate delimitation of known species, and even the introduction of nomenclatorial changes, have caused confusion and have led to the use of scientific names that are incorrect by modern standards, or apply to more than one species. Although great care was exercised in selecting the published information used in the catalogue, some misjudgements and incorrect interpretations have undoubtedly occurred.

In order to avoid cluttering the text with literature citations, every effort was made to restrict these to papers considered of specific relevance to the species in question. Many others, particularly on systematics, anatomy, distribution and the more general aspects of biology and fisheries, have been included only in the bibliography. Attention is drawn to the existence of rather comprehensive, even if often outdated bibliographies on this group or on parts of it, e.g. Corwin (1930), Shimada (1951), volume 4 of the 'Proceedings of the World Scientific Meeting on the Biology of Tunas and Related Species' (Bernabei, ed., 1964), LeGall (1981), and the annotated bibliography on eggs and juveniles by Richards & Klawe (1972). For more detailed information, particularly on tuna and mackerel stocks and their fisheries, the reader is referred to specialized periodical publications, such as the 'Bulletin' and the 'Annual Reports' of the Inter-American Tropical Tuna Commission (La Jolla), the 'Collective Volume of Scientific Papers' of the International Commission for the Conservation of Atlantic Tunas (Madrid), and the 'Fisheries Newsletters and Reports of the Skipjack Survey and Assessment Programme' of the South Pacific Commission (Noumea). Recent comprehensive papers on certain groups of scombrids include Manooch, Nakamura & Hall (1978) on four Atlantic species of Scomberomorus, Yoshida (1979) on little tunas (Euthynnus), Yoshida (1980) on bonitos (Sarda), Uchida (1981) on frigate tunas (Auxis), and Collette & Russo (ms) on the Spanish mackerels (Scomberomorus). Species synopses are individually quoted in the text where relevant.

Illustrations were adapted and redrawn by Mr Paolo Lastrico, FAO (Rome), from a wide variety of sources, especially primary systematic literature. Most figures of Spanish mackerels were drawn from specimens by Ms Keiko Hiratsuka Moore of the NMFS Systematics Laboratory (Washington, D.C.).

**Acknowledgements**

The authors and the editor wish to express their thanks to all those who have contributed to the preparation of this catalogue, and in particular to Drs W.L. Klawe, I-ATTC, La Jolla, California; A.D. Lewis, Ministry of Agriculture and Fisheries, Fiji; E.L. Nakamura, SEFC, Panama City, Florida; I. Nakamura, Kyoto University, Kyoto; and G.D. Sharp, FAO, Rome, for their constructive criticism of the first draft; and to Dr J.-C. Quéro, Institut Scientifique et Technique des Pêches Maritimes, La Rochelle, for his collaboration in selecting French FAO names. Special thanks are also due to Mr Paolo Lastrico, FAO, Rome and Ms Keiko Hiratsuka Moore, NMFS, Washington, for the preparation of species illustrations, Mrs Giulia Sciarappa-Demuro for her patience with the typing of the never-ending amendments to the manuscript, and Ms Gloria A. Soave for revising the bibliography. Last not least, it should be emphasized that the preparation of this document would not have been possible without financial support from UNDP under the Survey and Identification of World-Marine Fish Resources Project (GLO/82/001).

## 1.1 Plan of the Catalogue

This catalogue is arranged alphabetically by genera and species. Each of the multispecies genera is introduced with general descriptive remarks, illustrations of diagnostic features, highlights on the biology, and relevance to fisheries. The information pertaining to each species is arranged by paragraphs, as follows: (1) scientific name, (2) synonymy, (3) FAO species names, (4) diagnostic features, (5) geographical distribution, (6) habitat and biology, (7) size, (8) interest to fisheries, (9) local species names, (10) literature, and (11) remarks.

(1) **Scientific name :** Reference is given to the original description of each species so no confusion will arise as to precise identification.

(2) **Synonymy:** Synonyms and different name combinations are listed (misidentifications and other nomenclatorial problems are discussed under (11) remarks).

(3) **FAO species names :** English, French and Spanish names for each species, to be used primarily within FAO, were selected on the basis of the following criteria: (i) each name must apply to one species only, in a worldwide context; (ii) the name should not lead to confusion with other groups. Wherever possible, the names selected were based on vernacular names (or parts of names) already in existence within the areas where the species is fished. FAO species names are, of course, not intended to replace local species names, but they are considered necessary to overcome the considerable confusion caused by the use of a single name for many different species, or several names for the same species.

(4) **Diagnostic features :** Distinctive characters of the species are given as an aid for identification, accompanied by pertinent illustrations. Species identifications should be attempted only after consultation of the illustrated key to genera and species. Reference to FAO Species Identification Sheets is given wherever relevant.

(5) **Geographical distribution :** The entire known geographic range of the species, including areas of seasonal occurrence, is given in the text and shown on a small map. In cases where only scattered records of occurrence are available, interrogation marks have been used to indicate areas of suspected distribution.

(6) **Habitat and biology :** The known depth range of the species, and information on salinity and temperature of its habitat are given where known. Information on biological aspects, such as migrations, spawning seasons and areas, food, predators,and longevity is also included.

(7) **Size :** The maximum known, as well as the common fork length and weight (if available) are given. Fork length is measured from the tip of the snout to the tip of the caudal rays in the middle of the fork of the tail. The all-tackle angling record and length at first maturity are given where known.

(8) **Interest to fisheries :** This paragraph gives an account of the areas where the species is fished and of the nature of the fishery; its importance is either qualitatively estimated or actual figures of annual landings are provided. Data on utilization (fresh, dried, frozen, canned, etc.) are also given where available. Here too, the quality and quantity of the information available vary considerably with the species.

(9) **Local species names:** These are the names used locally for the various species. The present compilation is necessarily incomplete, since only a fraction of the local names used throughout the world is actually published. In many cases, local names are available only for species supporting documented fisheries. Apart from possible omissions due to limitations of literature available, some of the names included may be somewhat artificial (i.e. through transliteration of indigenous words into English). The local species name is preceeded by the name of the country concerned (in capital letters) and, where necessary, by geographical specifications (in lower case). Whenever possible, the language of the transcribed vernacular name is added in parenthesis. When more than one name is used within a country, the official name, if available, is underlined.

(10) **Literature :** This includes references to the most important publications relevant to the species, the emphasis being on biology and fisheries. Additional references are included in the bibliography. In the case of a few uncommon species, only systematic papers are available.

(11) **Remarks :** Important information concerning the species and not fitting in any of the previous paragraphs is given here. For instance, in some cases the scientific name used in the present catalogue, although nomenclaturally correct, is not the best known. Other nomenclatural problems, such as the use of subspecies, are discussed.

## 1.2 General Remarks on Scombrids

The Scombridae is a family composed of 15 genera and 49 species of mostly epipelagic marine fishes, the mackerels, Spanish mackerels, bonitos, and tunas. Some of their major morphological features have been discussed and illustrated by Collette (1979). The family Scombridae is divisable into two subfamilies: the Gasterochismatinae, which contain only the peculiar Southern Ocean Gasterochisma melampus, and the Scombrinae. On the basis of internal osteological characters, Collette & Chao (1975), and Collette & Russo (1979) have divided the Scombrinae into two groups of tribes (Fig. 1). The more primitive mackerels (Scombrini) and Spanish mackerels (Scomberomorini) are characterized by: (i) a distinct notch in the hypural plate that supports the caudal fin rays, (ii) the absence of a bony support for the median fleshy keel (when present), and (iii) preural vertebrae centra not greatly shortened as compared to the other vertebrae. Grammatorcynus shares the characteristics of the Scomberomorini but has other features indicating that it is more primitive than Scomberomorus and Acanthocybium. The bonitos (tribe Sardini as characterized by Collette & Chao, 1975) are a group of five genera and eight species that are intermediate between the Spanish mackerels (tribe Scomberomorini) and the higher tunas (tribe Thunnini). They lack any trace of a specialized subcutaneous vascular system or dorsally projecting cartilaginous ridges on the tongue, and the bony structure underlying their median fleshy caudal peduncle keel is incompletely developed; they also lack the prominent paired frontoparietal fenestra on the dorsal surface of the skull characteristic of all Thunnini (except Auxis). The four genera of Thunnini are unique among bony fishes in having counter-current heat exchanger systems that allow them to retain metabolic heat so that the fish is warmer than the surrounding water. The three more primitive genera of this tribe (Auxis, Euthynnus and Katsuwonus) and the yellowfin group of Thunnus have central and lateral heat exchangers while the specialized bluefin group of Thunnus have lost the central heat exchanger and evolved very well-developed lateral heat exchangers (Carey et al., 1971; Graham, 1973, 1975). These and other physiological and morphological adaptations are of great interest to physiologists and evolutionary biologists.

The family Scombridae is essentially confined to marine waters. Spanish mackerels (Scomberomorus) enter estuaries to feed and are generally restricted to coastal waters. Most species of Spanish mackerel have fairly restricted ranges, two in the eastern Pacific, four in the western Atlantic, one in the eastern Atlantic, and 11 in parts of the Indo-West Pacific. One species (Scomberomorus sinensis) moves long distances in freshwater up the Mekong River into Kampuchea. Bonitos (Sarda) and little tunas (Euthynnus) are also primarily coastal fishes but the distribution of individual species is more widespread, e.g. Sarda sarda and Euthynnus alletteratus throughout the Atlantic Ocean. Tunas generally prefer more oceanic habitats; five of the seven species of Thunnus are found worldwide and are known to migrate extensively.

Scombrids are dioecious (separate sexes) and most display little or no sexual dimorphism in structure or colour pattern. Females of many species attain larger sizes than males. Batch spawning of most species takes place in tropical and subtropical waters, frequently inshore. The eggs are pelagic and hatch into planktonic larvae. Scombrids are active predators. The mackerels (Scomber and Rastrelliger) filter plankton out of the water with their long gillrakers. The Spanish mackerels, bonitos, and tunas feed on larger prey, small fishes, crustaceans, and squids. The main predators of smaller scombrids are other predacious fishes, particularly larger scombrids and billfishes. Being at least tertiary, if not top predators, large tunas (Thunnini) are less numerous and are landed in lesser quantities than the mackerels (Scombrini). The latter accounted for almost two thirds of the world catch of scombrids for many years, even though their share in the catches has recently decreased (about 56% of total scombrid landings in 1981).

Mackerels and tunas support very important commercial and recreational fisheries as well as substantial artisanal fisheries throughout the tropical and temperate waters of the world. World catches oscillated between 5.2 million tons in 1975 and 4.9 million tons in 1981 hitting a maximum of 6.1 million tons in 1978 (FAO, 1983) (Table I). Catches in cold and warm temperate waters predominate over tropical catches, with more than half of the world catch being taken in the northwestern Pacific, the northeastern Atlantic and the southeastern Pacific (Fishing Areas 61, 27 and 87). Many species of tunas and mackerels are the target of long-distance fisheries. The principal fishing methods used for fish schooling near the surface include purse seining, driftnetting, hook and line/bait boat fishing, and trolling; standard and deep longlining are used for (usually bigger) fish occurring at least temporarily in deeper water. Supply of sufficient quantities of suitable baitfish has turned out to be the major bottleneck for the pole and line fishery in recent years. Experimental studies of baitfish culture aimed at overcoming this problem have proved discouraging. Recreational fishing methods involve mostly surface trolling and pole-and-line fishing, while the numerous artisanal fisheries deploy a great variety of gear including bag nets, cast nets, lift nets, gill (drift) nets, beach seines, hook-and-line, handlines, harpoons, specialized traps, and fish corrals.

Virtually all scombrids are highly appreciated fish for their high quality flesh. While mackerels and Spanish mackerels are marketed fresh, frozen, canned, smoked and salted, most of the catch of tunas is canned, though they may also be marketed fresh.

As a result of rocketing fuel prices in the last decade, more sophisticated spotting methods have been introduced in scombrid fisheries for the purpose of reducing expensive search time. Such methods include satellite imagery, airplane spotting and more efficient use of monthly surface temperature charts and other hydrographical information that can now more reliably be applied with our increased understanding of the correlation between environmental parameters and scombrid behaviour.

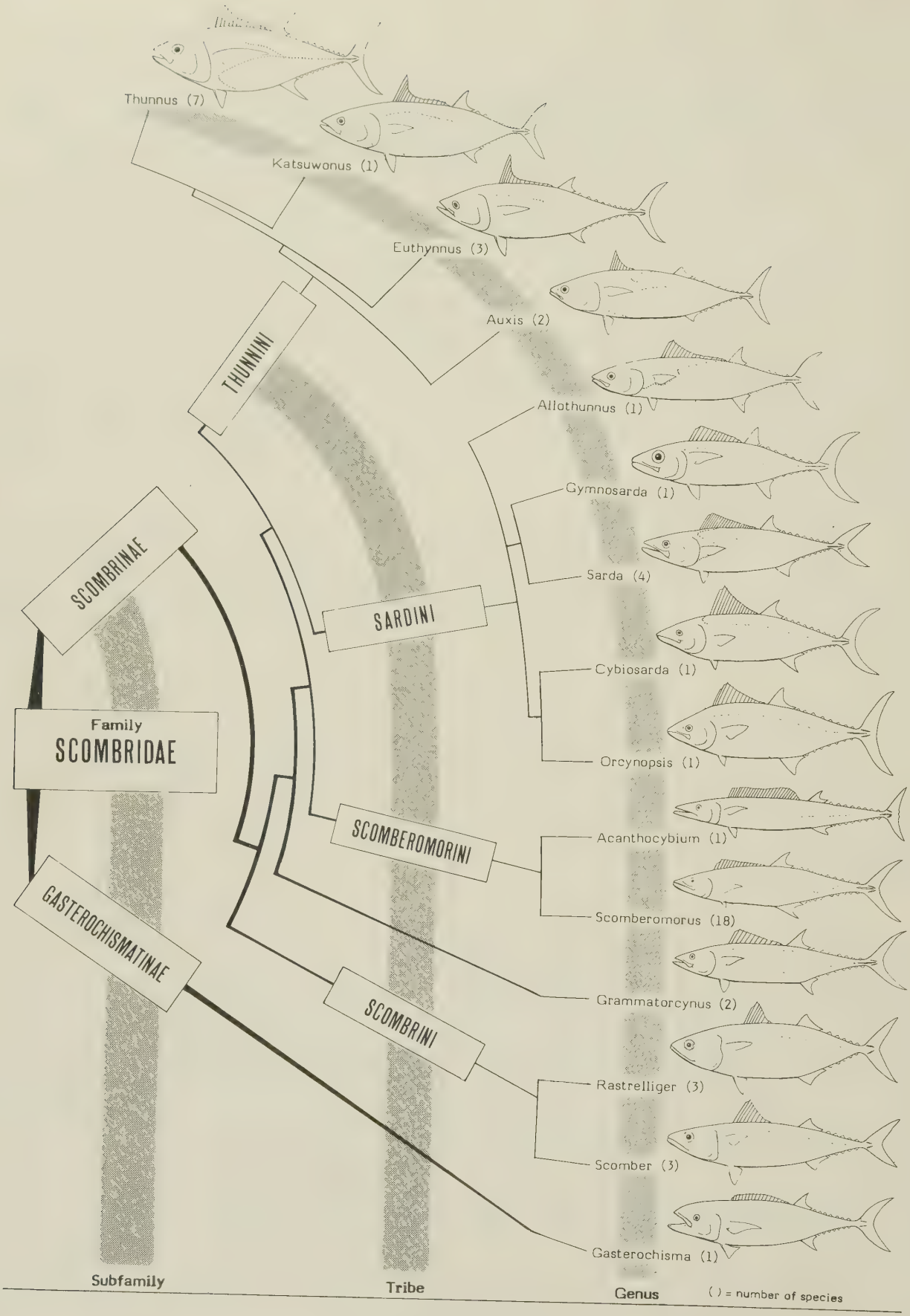



Fig. 1 Classification of Scombrids

TABLE I

**Estimated world catch of Scombrids in metric tons (source: FAO, 1983)**

| Systematic Category | 1975 | 1978 | 1979 | 1980 | 1981 |
|---|---|---|---|---|---|
| Scomber | 3 053 427 | 3 565 530 | 3 239 211 | 2 912 052 | 2 378 518 |
| Rastrelliger | 286 292 | 375 388 | 355 580 | 372 663 | 366 699 |
| Unspecified Scombrini | 12 328 | 26 081 | 22 404 | 23 546 | 23 549 |
| Subtotal Scombrini | 3 352 047 | 3 966 999 | 3 617 195 | 2 912 052 | 2 768 766 |
| Acanthocybium | 78 | 58 | 59 | 218 | 89 |
| Scomberomorus | 193 843 | 192 021 | 207 873 | 222 718 | 252 209 |
| Subtotal Scomberomorini | 193 921 | 192 079 | 207 942 | 222 936 | 252 298 |
| Orcynopsis | 104 | 980 | 501 | 696 | 1 068 |
| Sarda | 35 771 | 28 436 | 30 717 | 50 088 | 57 321 |
| Subtotal Sardini | 35 875 | 29 416 | 31 218 | 50 784 | 58 389 |
| Auxis | 58 659 | 75 760 | 108 726 | 137 040 | 108 689 |
| Euthynnus | 65 943 | 70 754 | 56 842 | 53 876 | 78 196 |
| Katsuwonus | 551 277 | 796 034 | 705 973 | 771 286 | 697 760 |
| Thunnus | 949 352 | 1 033 289 | 999 993 | 970 766 | 955 417 |
| Unspecified Thunnini | 1 | 9 | 33 | 675 | 352 |
| Subtotal Thunnini | 1 652 232 | 1 975 846 | 1 871 567 | 1 932 990 | 1 840 414 |
| GRAND TOTAL | 5 207 075 | 6 164 340 | 5 727 922 | 5 118 784 | 4 919 867 |

## 1.3 Illustrated Glossary of Technical Terms and Measurements

### Measurements Used

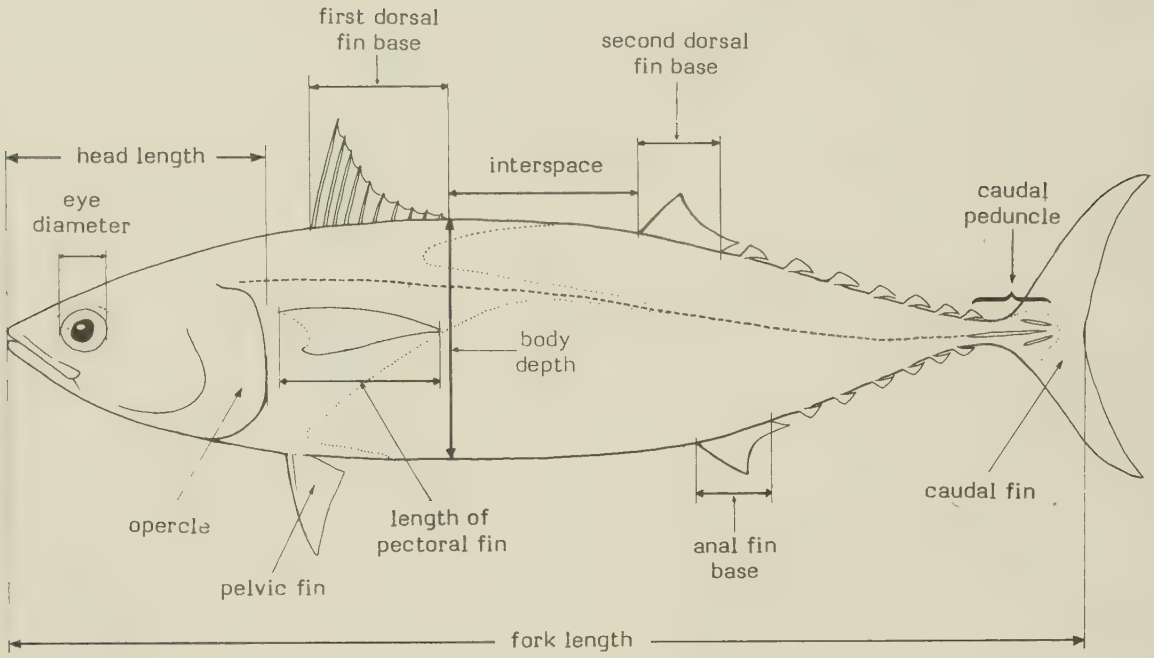



Fig. 2 Schematic illustration of a Scombrid (Auxis thazard)

### Glossary of Technical Terms

**Adipose eyelid** - Translucent fold covering anterior and posterior margins of eye in mackerels (Scomber and Rastrelliger) (Fig. 3).

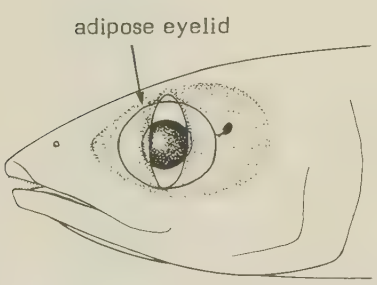
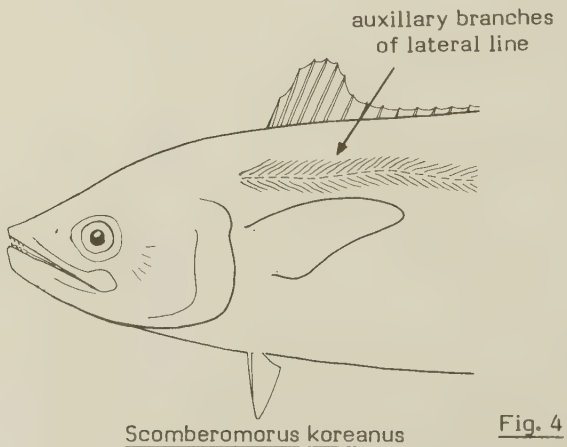



Fig. 3

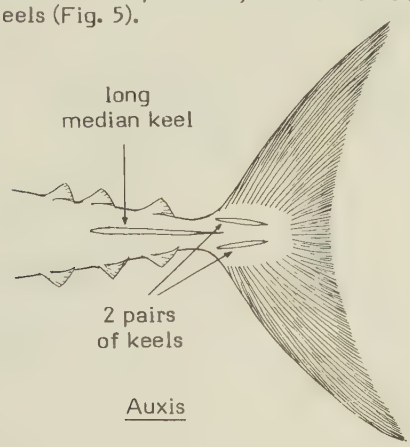
**Auxillary branches of lateral line** - Fine branches that extend dorsally and ventrally from the anterior part of the lateral line in Scomberomorus guttatus and S. koreanus (Fig. 4).




Scomberomorus koreanus

Fig. 4

**Caudal keel** - All members of the Scombridae have a pair of small obliquely oriented keels at the base of the caudal fin. The more advanced members of the family also have a large median keel on the middle of the caudal peduncle, anterior to the pair of small keels (Fig. 5).




Auxis

Fig. 5

**Caudal peduncle** - The narrow part of the body just anterior to the caudal fin (see illustration of measurements).

**Caudal vertebrae** - Vertebrae that bear a haemal spine ventral to the vertebral centrum (Fig. 6b). The first caudal vertebra is located near the origin of the anal fin. Caudal vertebrae lack pleural ribs which are characteristic of the precaudal vertebrae.

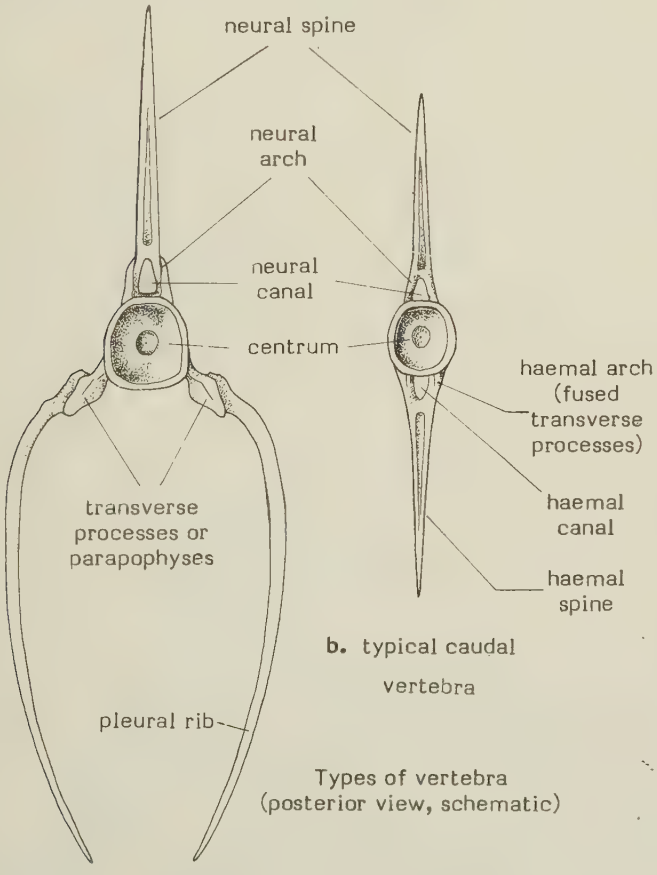



Fig. 6

**Corselet** - The large thick scales that cover the anterior part of the body in advanced scombrids (Fig. 7).

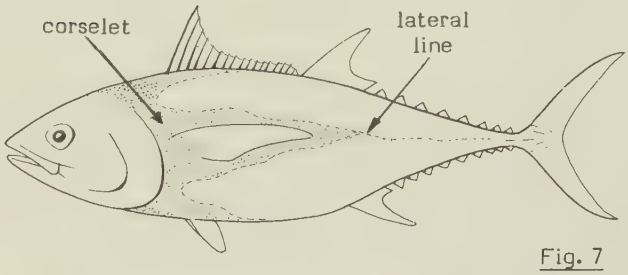



Fig. 7

**Cutaneous arteries and veins** - Special parts of the circulatory system that lie under the skin and enable tunas to conserve metabolic heat and be warmer than the water in which they live.

**Fin groove** - The first, or spiny, dorsal fin folds down into a groove on the dorsal surface of the body in all scombrids when they are swimming rapidly.

**Fin membrane** - The thin membranes between the spines of the first dorsal fin (Fig. 8).

**Fin rays** - General term for the soft rays and spines that support the fins (Fig. 8).

**Fin spines** - The sharp, pointed structures that support the first dorsal fin (Fig. 8).

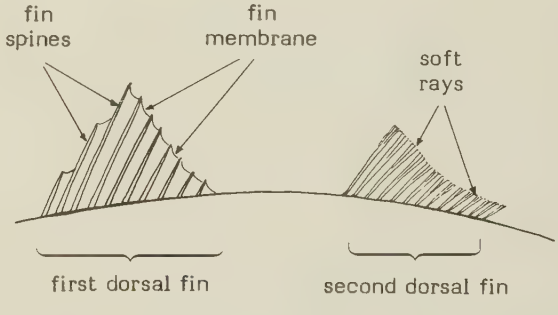
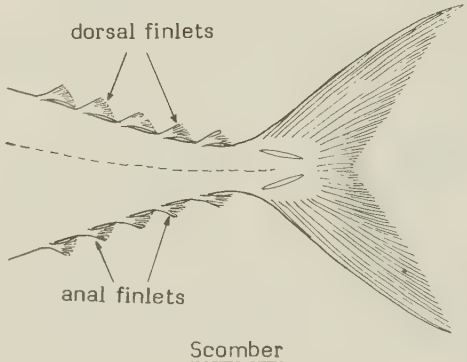



Fig. 8

**Finlets** - The small individual fins posterior to the second dorsal and anal fins (Fig. 9).




Scomber

Fig. 9

**Gill arch** - The j-shaped structure under the gill cover that bears the gill filaments. There are 4 gill arches on each side in scombrids (Fig. 10).

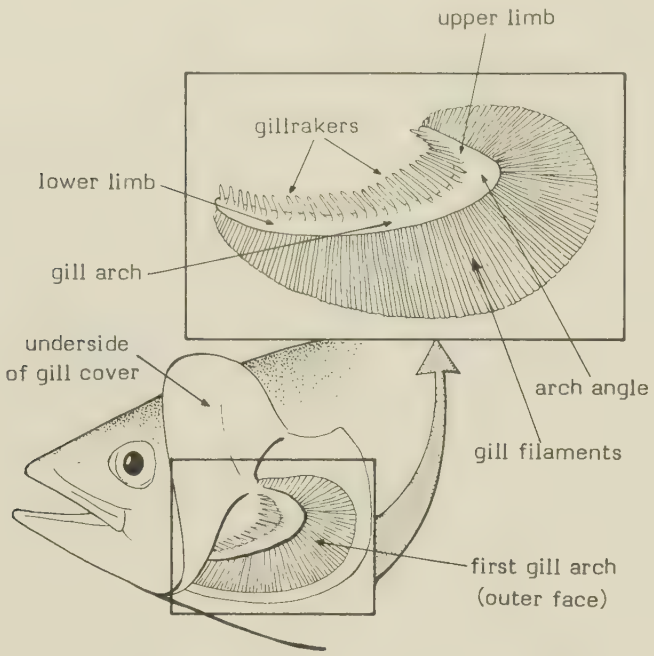
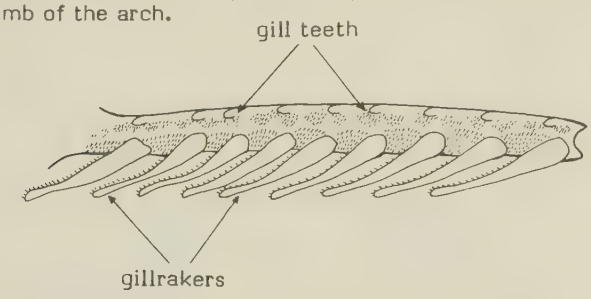



Fig. 10

**Gill teeth** (or inner gillrakers) - Short, flattened structures on the gill arch located medially from the gillrakers (Fig. 11). Counted like the gillrakers, teeth on upper limb plus those on lower limb of the arch.



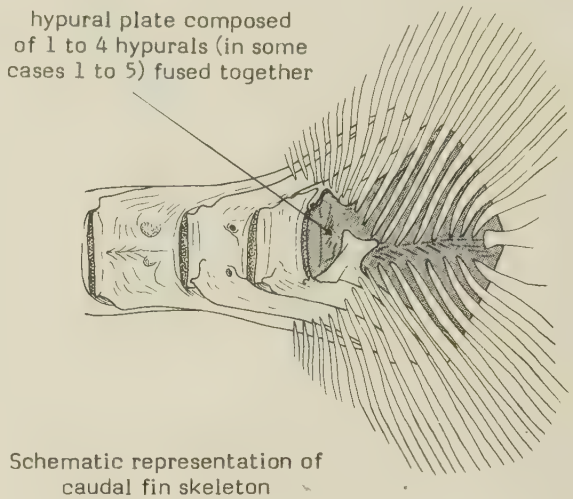

part of lower limb
of gill arch seen
from above

Fig. 11

**Gillrakers** - The stiff pointed structures that extend dorsally or anteriorly from the first gill arches towards the mouth. Counts of gillrakers are usually given as the number on the upper limb of the first arch plus the number on the lower limb of the first arch, e.g. 4 + 12 = 16. In scombrids there is usually one at the angle between the upper and lower limbs that is not clearly on either the upper or lower, leading to counts of 4 + 1 + 11 = 16. If not enumerated separately, this gillraker is added to those on the lower arch, 4 + 12 = 16 (Fig. 10).

**Haemal spines** - The spine that extends ventrally from the centra of the caudal vertebrae (Fig. 6b). The first vertebra with a haemal spine is the first caudal vertebra.

**Hypural plate** - The expanded ends of the hypural bones form a wide plate onto which the caudal fin rays insert (Fig. 12). Scombrids differ from most other fishes in having the caudal fin rays so deeply divided that they completely cover the hypural plate (Fig. 12).

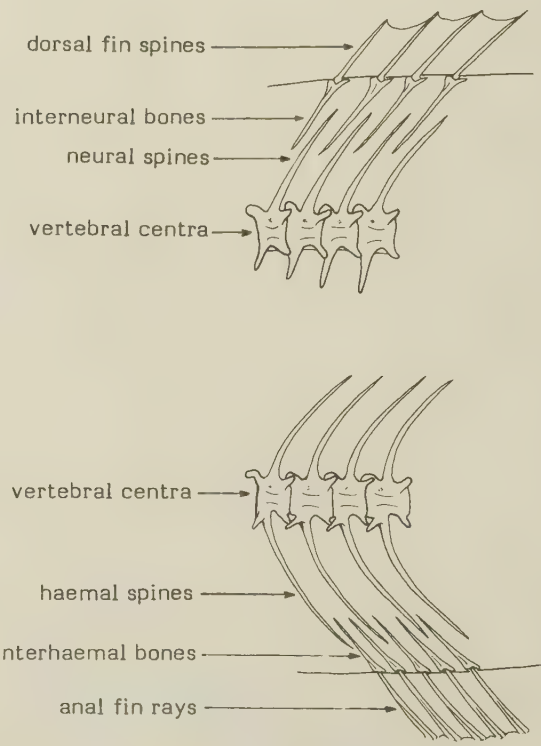



Schematic representation of
caudal fin skeleton
(Orcynopsis)

Fig. 12

**Interhaemal bones** - Bones located between the haemal spines of the caudal vertebrae and the rays of the anal fin (Fig. 13)

**Interneural bones** - Bones located between the neural spines of the vertebrae and the rays of the dorsal fins (Fig. 13).




Position of interneural and
interhaemal bones (schematic)

Fig. 13

**Interpelvic process** - A fleshy process between the inner edges of the pelvic fins. This process may be single (Fig. 14a), or bifid (Fig. 14b), small or large.

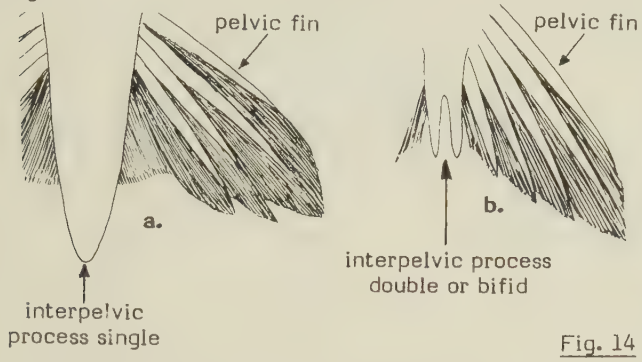
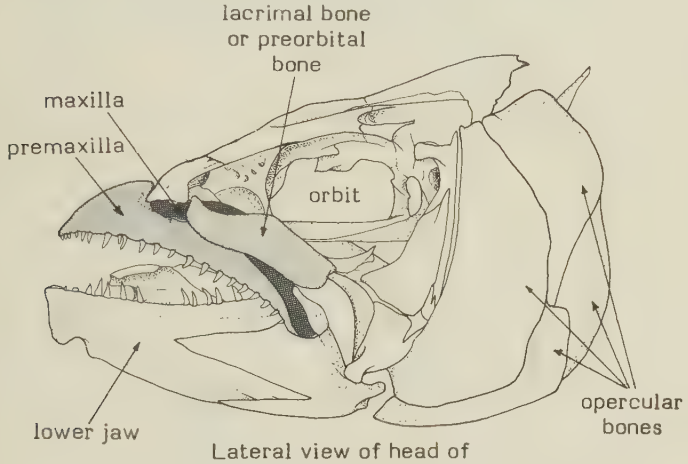



Fig. 14

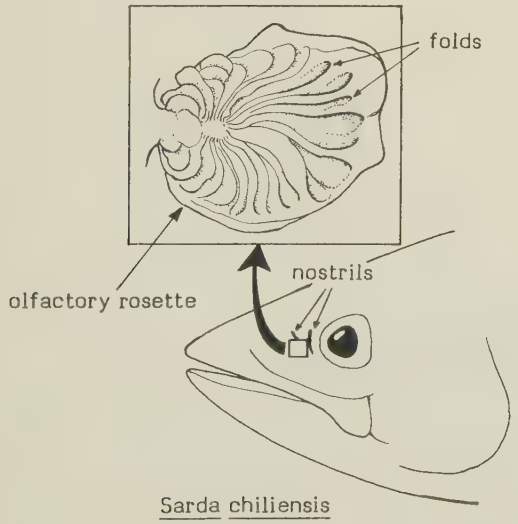
**Lacrimal bone** - The largest of the infra-orbital series of bones, located ventral and slightly anterior to the eye. Also known as the preorbital bone (Fig. 15).




Lateral view of head of Gymnosarda unicolor

Fig. 15

**Laminae of the olfactory rosette** - Fleshy folds (laminae) containing cells that can detect odours are arranged in a circular pattern (rosette) under the area between the anterior and posterior openings of the nostrils (Fig. 16).




Sarda chiliensis

Fig. 16

**Lateral line** - A series of sense organs enclosed in tubular scales along the side of the body (Figs 4, 7). Most scombrids, like other fishes, have a single lateral line, but Grammatorcynus species have two.

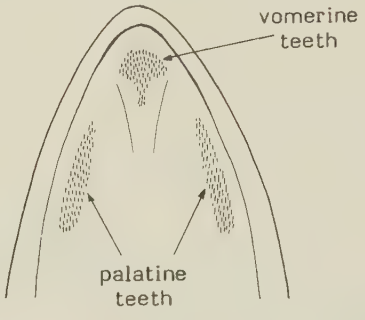
**Liver striations** - The ventral surface of the liver of 4 species of tunas bears prominent striations. These striations are blood vessels involved in a counter-current heat exchanger system that enables these species to have warm viscera (Fig. 17)

Thunnus alalunga

Fig. 17

**Maxilla** - The supporting bone for the premaxilla, the bone in the upper jaw that bears teeth (Fig. 15).

**Palatine** - A plow-shaped bone, the ventral margin of which lies in the roof of the mouth. The palatine bone may be toothed (Fig. 18), bearing either a row of conical teeth or a patch of fine villiform teeth.




roof of mouth showing location of dentition (schematic)

Fig. 18

**Parapophysis** - Projection from the vertebral centra (Fig. 6a).

**Precaudal vertebrae** - The anterior vertebrae which lack a haemal spine. All but the first few bear pleural ribs (Fig. 6a).

**Preorbital bone** - Another name for lacrimal bone, the largest of the infraorbital series of bones (Fig. 15).

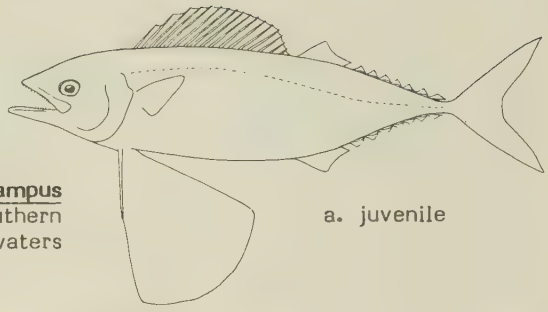
**Vertebral protuberances** - Rounded bumps on the lateral surface of some of the caudal peduncle vertebrae in several species of Euthynnus.

**Vomer** - A median skull bone, the ventral surface of which lies in the roof of the mouth. The vomer may bear teeth (Fig. 18).

## 2. SYSTEMATIC CATALOGUE

### 2.1 Illustrated Key to Genera and Species of Scombridae

1 a. Body covered with large cycloid scales; pelvic fins huge in juveniles (Fig. 19a), proportionally smaller at large sizes (Fig. 19b), depressable into a groove at all sizes ..... **Gasterochisma melampus**
Circumglobal in southern temperate waters



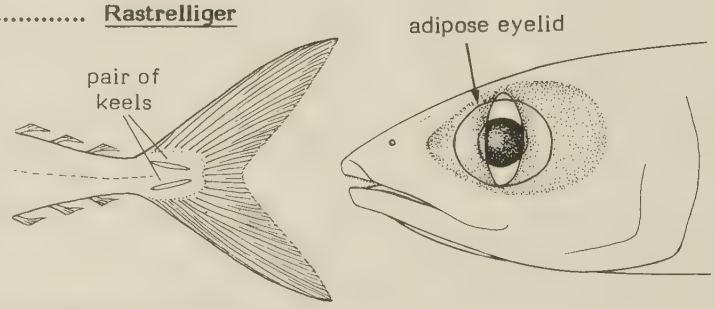
a. juvenile

1 b. Body naked or covered with small to moderate-sized scales; pelvic fins small, no groove into which they fit

Gasterochisma melampus b. adult Fig. 19

2 a. Two small keels on either side of caudal peduncle; 5 dorsal and 5 anal finlets (Fig. 20a); adipose eyelids cover front and rear of eye (Fig. 20b)

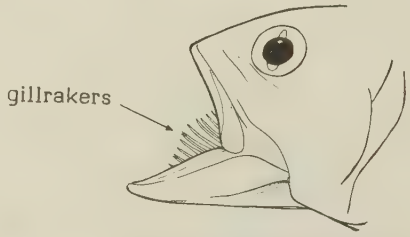
3 a. Entire body covered with moderately large scales; gillrakers very long, longer than gill filaments, plainly visible through open mouth (Fig. 21); no teeth on vomer or palatine bones ..... **Rastrelliger**




4 a. Gillrakers on lower half of first arch 21 to 26; body relatively slender, depth at posterior margin of opercle contained 4.9 to 6 times in fork length (Fig. 22); length of intestine equal to or less than fork length ..... **Rastrelliger faughni**
Indo-West Pacific to Fiji

Scomber Fig. 20

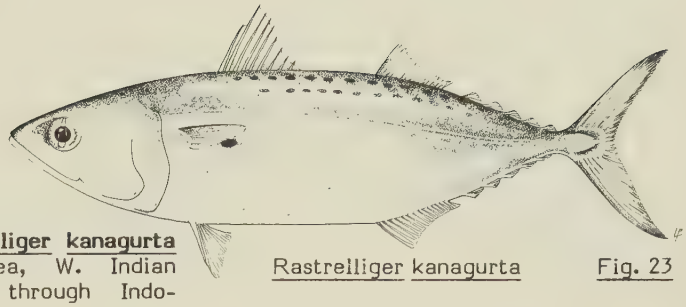
4 b. Gillrakers on lower half of first arch 30 to 48; body relatively deep, depth at posterior margin of opercle contained 3.7 to 5.2 times in fork length (Figs 23, 24); length of intestine 1.4 to 3.6 times the fork length




Rastrelliger brachysoma Fig. 21

Rastrelliger faughni Fig. 22

5 a. Body depth at posterior margin of opercle contained 4.3 to 5.2 times in fork length (Fig. 23); length of intestine 1.4 to 1.8 times the fork length ..... **Rastrelliger kanagurta**
Red Sea, W. Indian Ocean through Indo-West Pacific



Rastrelliger kanagurta Fig. 23

5 b. Body depth at posterior margin of opercle contained 3.7 to 4.3 times in fork length (Fig. 24); length of intestine 3.2 to 3.6 times fork length ..... **Rastrelliger brachysoma**
Indo-West Pacific

Rastrelliger brachysoma Fig. 24

3 b. Entire body covered with small scales; gillrakers shorter than gill filaments, barely visible through open mouth; teeth present on vomer and palatine bones ..... **Scomber**

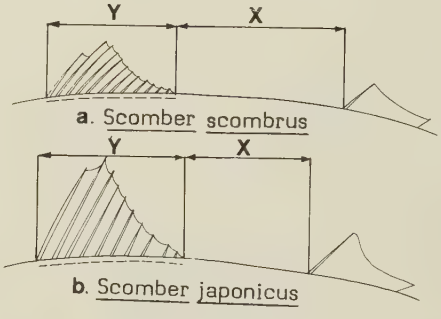



Fig. 25

6 a. Space between end of first dorsal fin groove and origin of second dorsal fin (x) greater than length of groove (y), about 1.5 times as long (Figs 25a,26); swimbladder absent; belly unmarked; 13 precaudal plus 18 caudal vertebrae; 21 to 28 interneural bones under first dorsal fin ..... **Scomber scombrus**
N. Atlantic, Mediterranean

Scomber scombrus Fig. 26

6 b. Space between end of first dorsal fin groove and origin of second dorsal fin (x) about equal to or less than length of groove (y) (Fig. 25b); swimbladder present; belly unmarked or marked by spots or wavy broken lines; 14 precaudal plus 17 caudal vertebrae; 12 to 20 interneural bones under first dorsal fin

7 a. First dorsal fin spines 9 or 10; distance from last dorsal spine to origin of second dorsal fin (x) less than distance between first and last spine (y) (Figs 27a,28); 12 to 15 interneural bones under first dorsal fin ..... **Scomber japonicus** NE. and NW. Pacific to Philippines, Hawaii, E.C. and SE. Pacific, Mediterranean and Black seas, E. and W. Atlantic, Red and Arabian seas

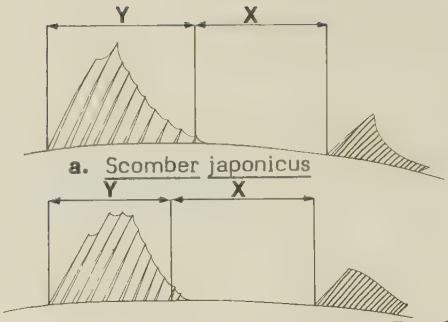
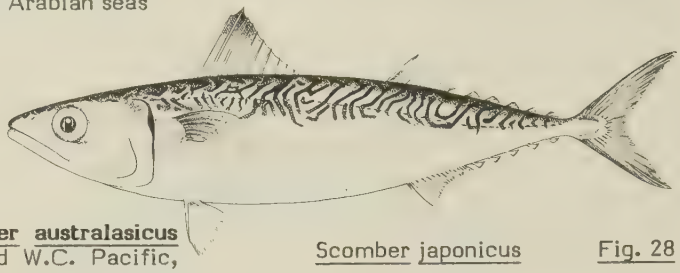



Fig. 27

7 b. First dorsal fin spines 10 to 13; distance from tenth dorsal spine to origin of second dorsal fin (x) greater than distance between first to tenth spine (y) (Figs 27b, 29); 15 to 20 interneural bones under first dorsal fin ..... **Scomber australasicus** NW. and W.C. Pacific, Hawaii, Socorro Isl., off Mexico, Southern Australia and New Zealand



Scomber japonicus Fig. 28

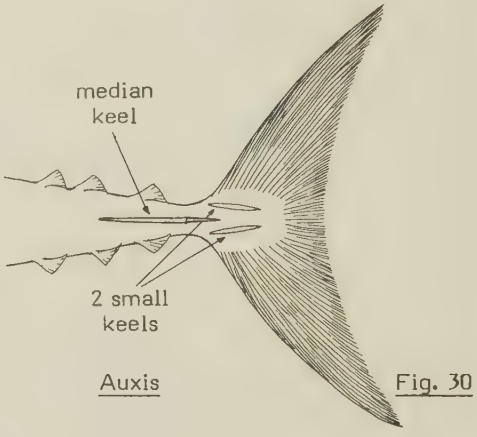
2 b. Two small keels and a large median keel between them on either side of caudal peduncle (Fig. 30); 7 to 10 dorsal and 6 to 10 anal finlets; adipose eyelids absent

Scomber australasicus Fig. 29

8 a. Two lateral lines, the lower joining the upper behind the pectoral fin base and at the caudal fin base; interpelvic process single and small (Fig. 33a); vertebrae 31 ..... **Grammatorcynus**

9 a. Eye small (3 to 4% of fork length); 14 or 15 gillrakers on first gill arch (Fig. 31). **Grammatorcynus bicarinatus** N., NE. and NW. coasts of Australia and southern Papua New Guinea

9 b. Eye large (7 to 9% of fork length); 19 to 24 gillrakers on first gill arch (Fig. 32).. **Grammatorcynus bilineatus** Red Sea, Indo-West Pacific to Marshall Isl. and south to Fiji and Tonga




Auxis Fig. 30

Grammatorcynus bicarinatus Fig. 31

Grammatorcynus bilineatus Fig. 32

8 b. One lateral line; interpelvic process single or double (Fig. 33a,b); vertebrae 41 to 64

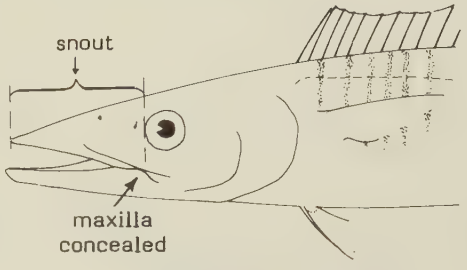
**a.** interpelvic process single

**b.** interpelvic process double

Fig. 33

10 a. Teeth in jaws strong, compressed, almost triangular or knife-like; corselet of scales obscure

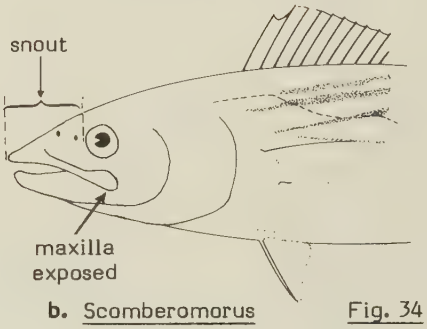
11 a. Snout as long as rest of head; no gillrakers; 23 to 27 spines in first dorsal fin; posterior end of maxilla concealed under preorbital bone (Figs 34a,35); vertebrae 62 to 64 ..... **Acanthocybium solandri**
Worldwide in tropical and subtropical waters




**a.** Acanthocybium solandri

11 b. Snout much shorter than rest of head; gillrakers on first arch 1 to 27; 12 to 22 spines in first dorsal fin; posterior end of maxilla exposed (Fig. 34b); vertebrae 41 to 56 ..... **Scomberomorus**

12 a. Lateral line with a deep dip below first or second dorsal fin (Figs 36,37,38); vertebrae 40 to 46




**b.** Scomberomorus

Fig. 34

13 a. Dip in lateral line below first dorsal fin (Fig. 36); total gillrakers on first arch 12 to 15; caudal vertebrae 21 or 22 ..... **Scomberomorus sinensis**
W.C. Pacific to Japan

13 b. Dip in lateral line below second dorsal fin (Figs 37, 38); total gill rakers on first arch 2 to 13; caudal vertebrae 23 to 27

Acanthocybium solandri

Fig. 35

Scomberomorus sinensis

Fig. 36

Scomberomorus cavalla Fig. 37

14 a. Total gillrakers on first arch 7 to 13; precaudal vertebrae 16 or 17 (Fig. 37) ..... **Scomberomorus cavalla**
W.C. Atlantic south to Rio de Janeiro, Brazil

Scomberomorus commerson Fig. 38

14 b. Total gillrakers on first arch 3 to 8; precaudal vertebrae 19 or 20 (Fig. 38) ..... **Scomberomorus commerson**
Red Sea, W. Indian Ocean through Indo-West Pacific

Scomberomorus concolor Fig. 39

12 b. Lateral line straight or descending gradually backwards; vertebrae 44 to 56

15 a. Total gillrakers on first arch 21 to 27; no spots or bars on body (Fig. 39) ..... **Scomberomorus concolor**
Baja California

15 b. Total gillrakers on first arch 1 to 18; spots, bars, or other markings usually present on sides of fish, except in S. multiradiatus

Scomberomorus multiradiatus Fig. 40

16 a. Anal fin rays 25 to 29; second dorsal fin rays 21 to 25, usually 23 or more; gillrakers on first arch 1 to 4; total vertebrae 54 to 56; no pattern on body (Fig. 40) ..... **Scomberomorus multiradiatus**
Papua New Guinea

16 b. Anal fin rays 15 to 24; second dorsal fin rays 15 to 24; total gillrakers on first arch 3 to 18; total vertebrae 44 to 53; sides usually with spots or other markings

17 a. Dorsal fin spines 19 to 22

18 a. First dorsal fin black between first and 5th to 7th spine, white posteriorly (Fig. 41); intestine straight with no folds; total vertebrae 48 to 50 ..... **Scomberomorus niphonius** Korea, Japan

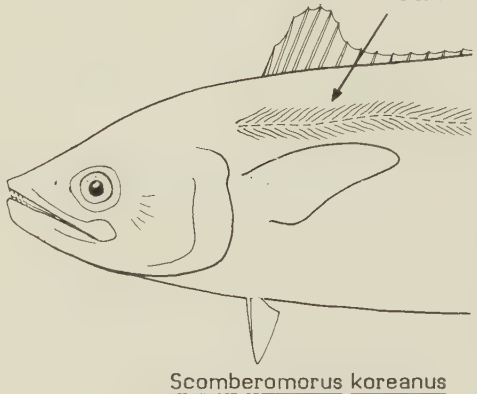
Scomberomorus niphonius Fig. 41

18 b. First dorsal fin black to or almost to posterior end (Fig. 42); intestine with 2 loops and 3 limbs; total vertebrae 50 to 52 ..... **Scomberomorus munroi** Australia except southern coast

Scomberomorus munroi Fig. 42

17 b. Dorsal fin spines 13 to 19, usually 18 or fewer

19 a. Lateral line with many small auxillary branches anteriorly (Fig. 43)




Scomberomorus koreanus Fig. 43

20 a. Dorsal fin spines 15 to 18, usually 16 or more; intestine with 2 loops and 3 limbs; total vertebrae 47 to 52, usually 50 or 51; head longer, 20.2 to 21.5% of fork length; body depth less, 22.8 to 25.2% of fork length (Fig. 44) ..... **Scomberomorus guttatus** Arabian Sea, Indo-West Pacific to Japan

Scomberomorus guttatus Fig. 44

20 b. Dorsal fin spines 14 to 17, usually 14 or 15; intestine with 4 loops and 5 limbs; total vertebrae 46 or 47, usually 46; head shorter, 19.7 to 20.4% of fork length; body depth greater, 24.4 to 26.7% of fork length (Fig. 45) ... **Scomberomorus koreanus** Indo-West Pacific to Japan

19 b. Lateral line without auxillary branches or with only a few anteriorly

Scomberomorus koreanus Fig. 45

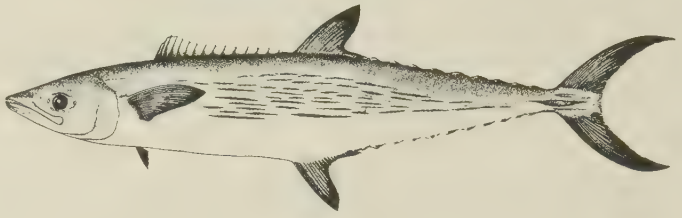
21 a. Sides with spots and at least one stripe, the stripes may be short, wavy or interrupted (Figs 46,47,48)

22 a. One long stripe on sides with spots or interrupted lines above and below the stripe (Fig. 46); total vertebrae 47 or 48, usually 48; total gillrakers on first arch 12 to 18, usually 15 or 16 ..... **Scomberomorus regalis**
to W.C. Atlantic

Scomberomorus regalis Fig. 46

22 b. Sides with several short stripes; total vertebrae 44 to 47; usually 46; total gillrakers on first arch 9 to 15, usually 14 or fewer

23 a. Sides with a series of short straight stripes and few if any spots (Fig. 47); total gillrakers on first arch usually 11 or fewer; second dorsal fin rays 15 to 19, rarely 21 or 22, usually 18 or fewer ..... **Scomberomorus lineolatus**
Indian Ocean



Scomberomorus lineolatus Fig. 47

23 b. Sides with a series of short wavy markings plus many small spots (Fig. 48); total gillrakers on first arch usually 12 or more; second dorsal fin rays 19 to 21, usually 20 or more .... **Scomberomorus plurilineatus**
SE. Africa

Scomberomorus plurilineatus Fig. 48

21 b. Sides without any stripes, spots usually present

24 a. Sides with bars or large spots, mostly larger than diameter of eye

25 a. Sides with relatively large round, regular spots or blotches (Fig. 49); total gillrakers on first arch 3 to 9, usually 7 or fewer .. **Scomberomorus queenslandicus**
Around Australia except southern and SW coasts

Scomberomorus queenslandicus Fig. 49

25 b. Sides either with bars or with irregular, vertically elongate spots; total gillrakers on first arch 6 to 15, usually 9 or more

26 a. First dorsal fin spines 13 to 15; second dorsal rays 19 to 22, usually 20 or more; total gillrakers on first arch 6 to 13, usually 11 or fewer; total vertebrae 44 to 46, usually 45; sides with broad cross bars (Fig. 50) tending to disappear in adults.... **Scomberomorus semifasciatus**
N. and NE. Australia

Scomberomorus semifasciatus Fig. 50

26 b. First dorsal fin spines 15 to 18, usually 16 or more; second dorsal rays 16 to 19, usually 17; total gillrakers on first arch 12 to 15; total vertebrae 46 or 47, usually 46; sides with irregular, elongate spots tending to form narrow cross bars in large adults (Fig. 51) ..... **Scomberomorus tritor**
E.C. Atlantic

Scomberomorus tritor Fig. 51

24 b. Sides with small round spots, at most about the diameter of eye, orange-coloured in life

27 a. Total vertebrae 51 to 53; second dorsal fin rays 17 to 20, usually 18 or more (Fig. 52) ..... **Scomberomorus maculatus**
W.C. Atlantic to Cape Cod

Scomberomorus maculatus Fig. 52

27 b. Total vertebrae 46 to 49; second dorsal fin rays 15 to 19, usually 18 or fewer

28 a. Pectoral fin rays 21 to 24, mostly 22 or 23; pelvic fin short, 3.6 to 5.9% of fork length (Fig. 53) ..... **Scomberomorus brasiliensis**
W.C. and SW. Atlantic

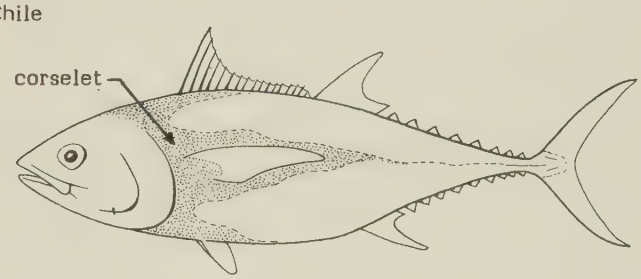
Scomberomorus brasiliensis Fig. 53

28 b. Pectoral fin rays 20 to 24, modally 21; pelvic fin longer, 4.7 to 6.4% of fork length (Fig. 54) ..**Scomberomorus sierra**
E.C. Pacific south to northern Chile

Scomberomorus sierra Fig. 54

10 b. Teeth in jaws slender, conical, hardly compressed; corselet of scales well developed (Fig. 55)

29 a. Upper surface of tongue without cartilaginous longitudinal ridges (Fig. 64a)




Thunnus sp. Fig. 55

30 a. Jaw teeth tiny, 40 to 55 on each side of upper and lower jaws; gillrakers fine and numerous, total of 70 to 80 on first arch; body elongate; distance from snout to second dorsal fin 61 to 65.4% of fork length; maxilla short, 35.4 to 37.9% of head length (Fig. 56) ..... **Allothunnus fallai**
Circumglobal in southern temperate waters

Allothunnus fallai Fig. 56

30 b. Jaw teeth larger and more prominent, 10 to 30 on each side of upper and lower jaws; total gillrakers on first arch 8 to 27; body less elongate; distance from snout to second dorsal fin 48.1 to 61% of fork length; maxilla longer, 43.1 to 55.7% of head length

Sarda sarda Fig. 57

31 a. Five to 10 narrow, dark longitudinal stripes on upper part of body (Figs 57 to 60); no teeth on the tongue; spleen prominent in posterior third of body cavity in ventral view ..... **Sarda**

32 a. Spines in first dorsal fin 20 to 23; total vertebrae 50 to 55 (Fig. 57) ..... **Sarda sarda**
Atlantic, Mediterranean and Black seas

32 b. Spines in first dorsal fin 17 to 19; total vertebrae 43 to 46

Sarda orientalis Fig. 58

33 a. Total gillrakers on first arch 8 to 13; supramaxilla narrow (Fig. 58) ..... **Sarda orientalis**
Indian and Pacific oceans

33 b. Total gillrakers on first arch 19 to 27; supramaxilla wider

Sarda australis Fig. 59

34 a. Total gillrakers on first arch 19 to 21; pectoral rays 25 to 27, modally 26; teeth sometimes present on vomer; length of first dorsal fin base 31.5 to 34.3% of fork length; maxilla 50.3 to 53.9% of head length (Fig. 59) ..... **Sarda australis**
SE. Australia and New Zealand

34 b. Total gillrakers on first arch 23 to 27; pectoral rays 22 to 26, modally 24 or 25; teeth never present on vomer, length of first dorsal base 26.7 to 31.4% of fork length; maxilla 46 to 50.3% of head length (Fig. 60) ..... **Sarda chiliensis**
Temperate E. Pacific

Sarda chiliensis Fig. 60

31 b. Body either without stripes or with dark spots above lateral line and longitudinal dark stripes below (Figs 61,62,63); two patches of teeth present on tongue; spleen either concealed or located in anterior third of body cavity in ventral view

35 a. Body with dark spots above lateral line and dark longitudinal stripes below; spines in first dorsal fin 16 to 18 (Fig. 61) ..... **Cybiosarda elegans**
Around Australia, except southern coast

Cybiosarda elegans Fig. 61

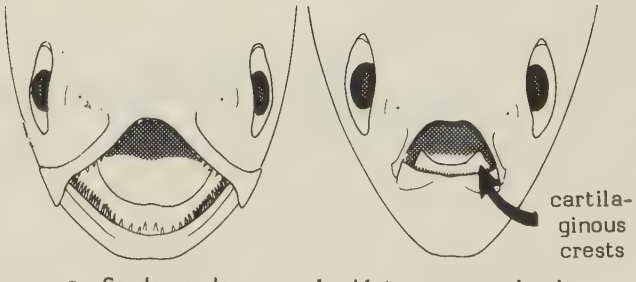
35 b. Body without a prominent pattern of stripes or spots; spines in first dorsal fin 12 to 15 (Figs 62,63)

36 a. Pectoral fin rays 21 to 23; small conical teeth in jaws; total gillrakers on first arch usually 14 or more; interpelvic process bifid (Fig. 33b); spleen not visible in ventral view; laminae in olfactory rosette 25 to 28; interorbital width 23.9 to 31% of head length (Fig. 62) ..... **Orcynopsis unicolor**
NE. Atlantic and Mediterranean

Orcynopsis unicolor Fig. 62

Gymnosarda unicolor Fig. 63

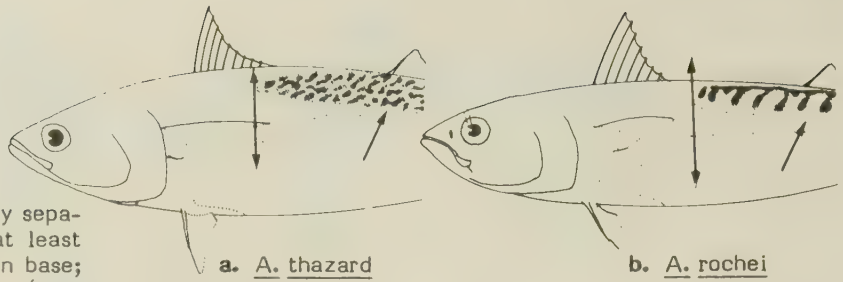
36 b. Pectoral rays 25 to 28; jaw teeth very large and conspicuous; total gillrakers on first arch usually 13 or fewer; interpelvic process single (Fig. 33a); spleen visible on right side of body cavity in ventral view; laminae in olfactory rosette 48 to 56; interorbital width 32.1 to 40% of head length (Fig. 63) ..... **Gymnosarda unicolor**
Red Sea, Indian Ocean, W. and C. Pacific




a. Sarda sarda b. Katsuwonus pelamis

Fig. 64

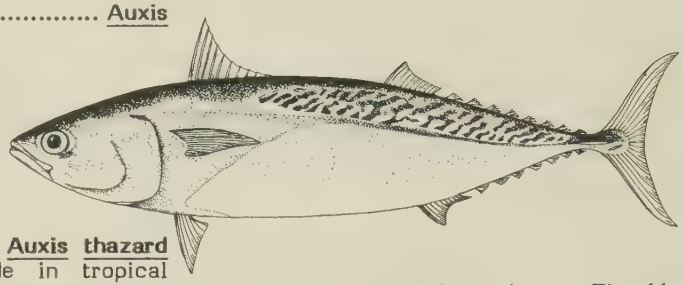
29 b. Upper surface of tongue with 2 longitudinal ridges (Fig. 64b)



a. A. thazard b. A. rochei

Fig. 65

37 a. First and second dorsal fins widely separated, the space between them at least equal to length of first dorsal fin base; 10 to 12 spines in first dorsal fin (Figs 65,66,67); interpelvic process single and long, at least as long as longest pelvic fin ray ..... **Auxis**



Auxis thazard Fig. 66

38 a. Posterior extension of corselet narrow, only 1 to 5 scales wide under origin of second dorsal fin; pectoral fin extends back beyond a vertical with the anterior margin of dorsal scaleless area (Figs 65a, 66) ..... **Auxis thazard**
Worldwide in tropical and temperate waters

Auxis rochei Fig. 67

38 b. Posterior extension of corselet much wider, usually 10 to 15 scales wide under origin of second dorsal fin; pectoral fin does not reach as far as dorsal scaleless area (Fig. 65b,67) ..... **Auxis rochei**
Worldwide in tropical and temperate waters

37 b. First and second dorsal fins barely separated, at most by a space equal to eye diameter; 12 to 16 spines in first dorsal fin; interpelvic process bifid and short, much shorter than pelvic fin rays (Fig. 33b)

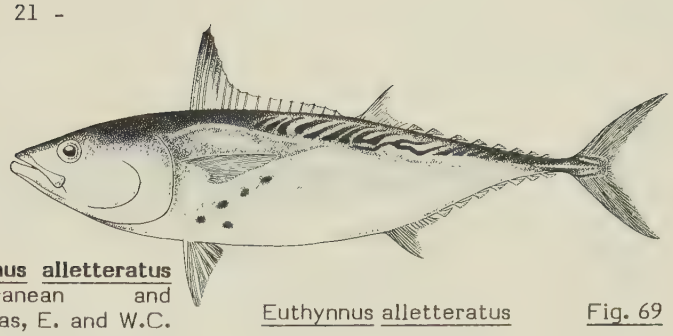
Katsuwonus pelamis Fig. 68

39 a. Three to five prominent dark longitudinal stripes on belly (Fig. 68); total gillrakers on first arch 53 to 63; total vertebrae 41 ..... **Katsuwonus pelamis**
Worldwide in tropical and warm temperate waters

39 b. No dark longitudinal stripes on belly; total gillrakers on first arch 19 to 45; total vertebrae 37 to 39

40 a. Body naked behind corselet of enlarged and thickened scales; several black spots usually present between pectoral- and pelvic-fin bases; back dark blue-green with a complex striped pattern under dorsal fin bases; pectoral fin rays 25 to 29 (Figs 69,70,71) ..... **Euthynnus**

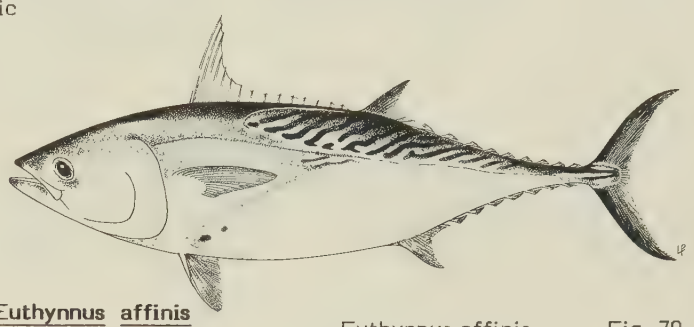
41 a. Vomerine teeth absent; total gillrakers on first arch 37 to 45 (Fig. 69) ..... **Euthynnus alletteratus** Mediterranean and Black seas, E. and W.C. Atlantic



Euthynnus alletteratus Fig. 69

41 b. Vomerine teeth present; total gillrakers on first arch 29 to 39

42 a. Total gillrakers on first arch 29 to 33; total vertebrae 39; bony caudal keels on vertebrae 33 and 34; no trace of vertebral protuberances (Fig. 70) ..... **Euthynnus affinis** Red Sea, W. Indian Ocean, Indo-West Pacific to Japan and Hawaii

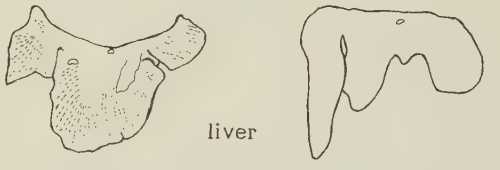


Euthynnus affinis Fig. 70

42 b. Total gillrakers on first arch 33 to 39; total vertebrae 37; bony caudal keels on vertebrae 31 and 32; 4 conspicuous protuberances on 31st and 32nd vertebrae (Fig. 71) ..... **Euthynnus lineatus** E.C. Pacific (and only accidentally to Hawaii)

Euthynnus lineatus Fig. 71

40 b. Body covered with very small scales behind corselet; no black spots on body; back dark blue without any striped pattern; pectoral fin rays 30 to 36 ..... **Thunnus**




T. thynnus, T. maccoyii, T. alalunga, T. obesus

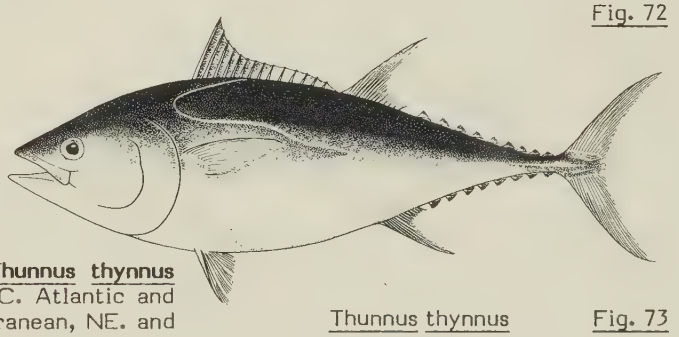
T. albacares, T. tonggol T. atlanticus

Fig. 72

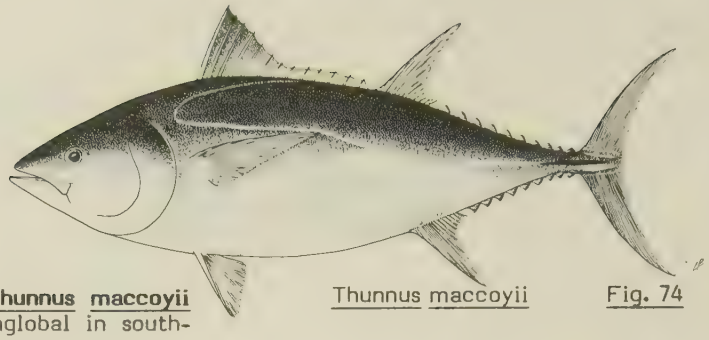
43 a. Ventral surface of liver with prominent striations; center lobe of liver equal to or longer then left or right lobes (Fig. 72a)

44 a. Total gillrakers on first arch 31 to 43; pectoral fin short, less than 80% of head length

45 a. Pectoral fin 16.8 to 21.7% of fork length; median caudal keel dark (Fig. 73); first ventrally directed parapophysis on 8th vertebra ..... **Thunnus thynnus** N. and C. Atlantic and Mediterranean, NE. and NW. Pacific



Thunnus thynnus Fig. 73



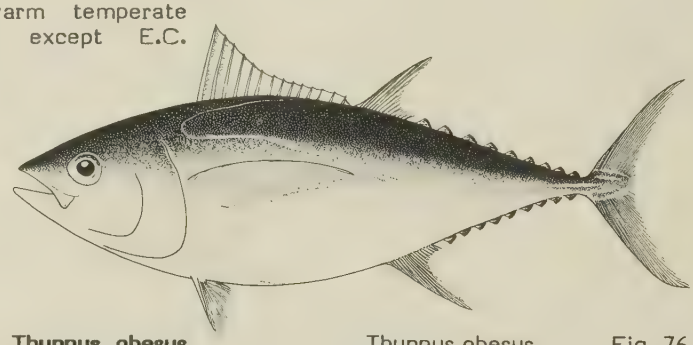
Thunnus maccoyii Fig. 74

45 b. Pectoral fin 20.2 to 23% of fork length; median caudal keel yellow (Fig. 74); first ventrally directed parapophysis on 9th vertebra ..... **Thunnus maccoyii**
Circumglobal in southern temperate waters

Thunnus alalunga Fig. 75

44 b. Total gillrakers on first arch 23 to 31; pectoral fin moderate or long, greater than 80% of head length

46 a. Caudal fin with a narrow white posterior margin; pectoral fin very long, reaching well past end of second dorsal fin base; greatest body depth at or slightly before level of second dorsal fin (Fig. 75) ..... **Thunnus alalunga**
Worldwide in tropical and warm temperate waters except E.C. Pacific



Thunnus obesus Fig. 76

46 b. Caudal fin without white posterior margin; pectoral fin short or moderate in length, not reaching end of second dorsal fin base (except in small individuals); greatest body depth about middle of body, near middle of first dorsal fin (Fig. 76) ..... **Thunnus obesus**
Worldwide in tropical and warm temperate waters

Thunnus albacares Fig. 77

43 b. Ventral surface of liver without striations; right lobe of liver much longer than left or central lobes (Fig. 72b)

47 a. Total gillrakers on first arch 26 to 34, usually 27 or more; second dorsal and anal fins of larger specimens (120 cm fork length or larger) elongate, more than 20% of fork length; maximum size is over 200 cm fork length (Fig. 77) ..... **Thunnus albacares**
Worldwide in tropical and warm temperate waters

47 b. Total gillrakers on first arch 19 to 28, usually 26 or fewer; second dorsal and anal fins never greatly elongate, less than 20% of fork length at all sizes; maximum size less than 110 cm fork length

48 a. Lower sides of body with a pattern of pale streaks and spots either horizontally oriented or without obvious orientation (Fig. 78); swimbladder absent or rudimentary; vertebrae 18 plus 21 = 39 ..... **Thunnus tonggol**
Red Sea, N. Indian Ocean, Indo-West Pacific to Japan and SE. Australia

Thunnus tonggol Fig. 78

48 b. Lower sides lacking pale streaks and spots, or with such markings at least partly in vertical rows (Fig. 79); swimbladder present; vertebrae 19 plus 20 = 39 ..... **Thunnus atlanticus**
NW. Atlantic south to Rio de Janeiro, Brazil

Thunnus atlanticus Fig. 79

Note The distribution patterns of red and white muscle in the body of scombrids show characteristic variations by species or groups of species and may be used as an additional aid to species identification, especially in the case of damaged specimens (see Fig. 80)

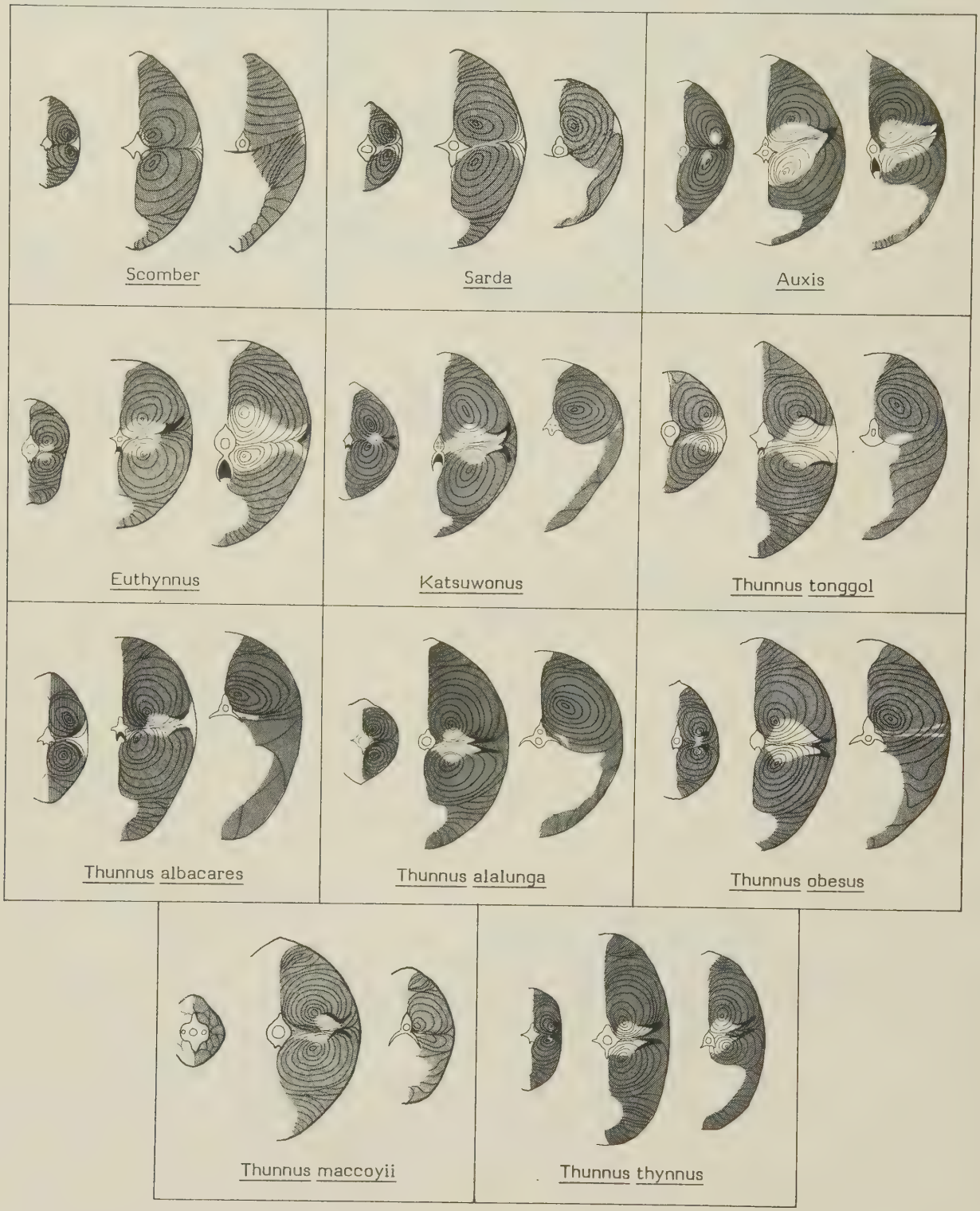



Fig. 80 Distribution of red muscle (white areas) and white muscle (grey areas) in eleven scombrid species. The three illustrations shown for each species correspond, from left to right, to cross sections at the following levels: (i) anterior end of the caudal keels, (ii) midpoint of body, and (iii) posterior edge of gill cover; black areas indicate location of the heat exchanger system. Adapted and redrawn after Sharp & Dizon, 1978.

## 2.2 Information by Species

**Acanthocybium** Gill, 1862 — SCOMBR Acan

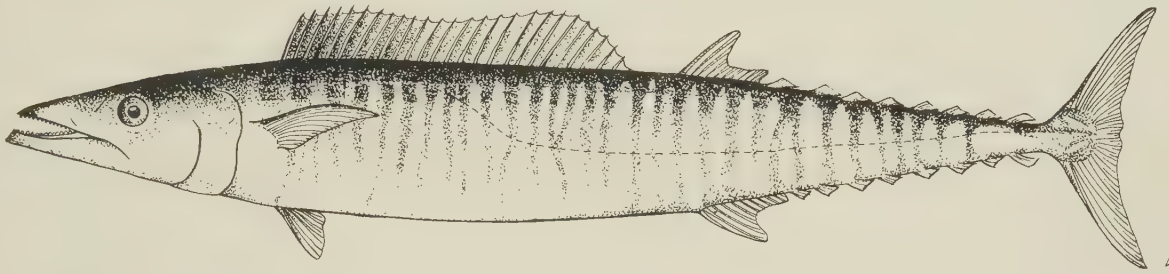
**Genus with reference :** Acanthocybium Gill, 1862. Type-species: Cybium sara Bennet, 1840 (= Cybium solandri Cuvier, 1831) by original designation.

**Acanthocybium solandri** (Cuvier, 1831) — SCOMBR Acan 1

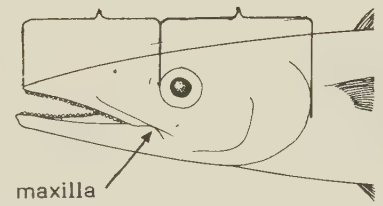
Cybium solandri Cuvier in Cuvier & Valenciennes, 1831; Histoire Naturelle des Poissons, 8:192-193 (based on Solander's manuscript, locality unknown).

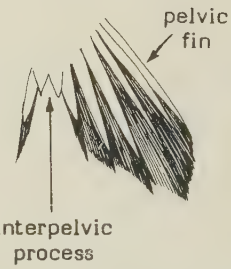
**Synonymy :** Cybium sara Lay & Bennett, 1839; Cybium petus Poey, 1860; Cybium verany Döderlein, 1871; Acanthocybium petus - Poey, 1875; Acanthocybium solandri - Lütken, 1880; Acanthocybium sara - Jordan, Tanaka, & Snyder, 1913; Acanthocybium solanderi - Fitch & Craig, 1964.

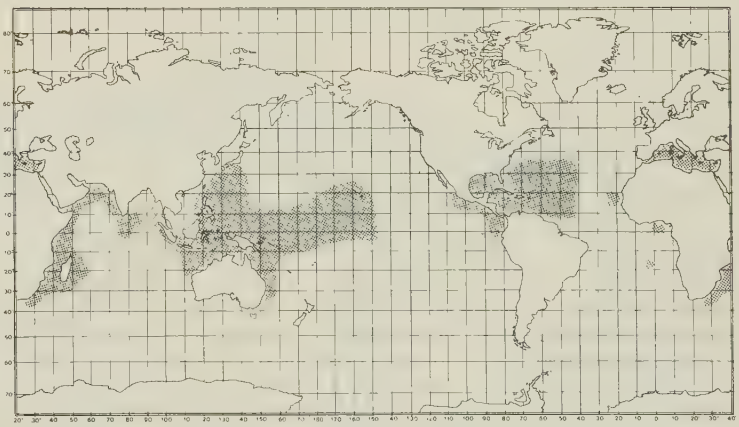
**FAO Names :** En - Wahoo; Fr - Thazard-bâtard; Sp - Peto.



**Diagnostic Features :** Body very elongate, fusiform and only slightly compressed. Mouth large with strong, triangular, compressed, and finely serrate teeth closely set in a single series; snout about as long as the rest of head; gillrakers absent; posterior part of maxilla completely concealed under preorbital bone. Two dorsal fins, the first with 23 to 27 spines, the second with 12 to 16 rays followed by 8 or 9 finlets; anal fin with 12 to 14 rays followed by 9 finlets; interpelvic process small and bifid. Lateral line single, abruptly curving downward under first dorsal fin. Body covered with small scales; no anterior corselet developed; caudal peduncle slender, with a well defined lateral keel between the two small ones on each side. Swimbladder present. Vertebrae 30 to 32 precaudal plus 31 to 33 caudal, total 62 to 64. Colour: back iridescent bluish green; sides silvery with 24 to 30 cobalt-blue vertical bars which extend to below lateral line, some doubled or y-shaped, becoming dusky-grey after death.



**Geographical Distribution :** Tropical and subtropical waters of the Atlantic, Pacific and Indian oceans including the Caribbean and Mediterranean seas.

**Habitat and Biology :** An epipelagic, oceanic species frequently solitary or forming small loose aggregations rather than compact schools.

Spawning seems to extend over a long period; fish in different maturity stages are frequently caught at the same time. Fecundity is believed to be quite high: some 6 million eggs per spawning were estimated for a 131 cm

long female. Wahoo are known to prey on scombrids, porcupinefishes (Diodontidae), flyingfishes (Exocoetidae), herrings and pilchards (Clupeidae), scads (Decapterus), lanternfishes (Myctophidae), other pelagic fishes and squids.

**Size :** Maximum size is 210 cm fork length and 83 kg or more. The all-tackle angling record is a 67.6 kg fish taken off Cat Bay, Bahamas in 1962. Size of the fish in most surface fisheries ranges between 100 and 170 cm fork length. Like other scombrids, wahoo show size variations associated with changes in latitude and hence, water temperature. Average weight tends to increase northwards and southwards of the equator (Iversen & Yoshida, 1957; Nakamura, 1952).

**Interest to Fisheries :** There do not appear to be any organized fisheries for this species but it is highly appreciated when caught. In a number of areas (Western Central Atlantic, Hawaiian Islands, Great Barrier Reef), it is primarily a gamefish taken on light to heavy tackle, surface trolling with spoons, feather lures, or strip bait (flying fish or halfbeak).

There is a longline base in Samoa where wahoo is landed as by-catch and canned for local consumption. Catches were reported from Venezuela, St. Helena, and Kiribati in the period from 1974 to 1981. They ranged between 58 and 218 metric tons per year (FAO, 1979, 1983). Wahoo is marked fresh, salted or spice-cured (slices of meat).

**Local Names :** BRAZIL: Cavalha empinge; COLOMBIA: Peto, Sierra, Sierra canalera, Wahoo; CUBA: Peto; DOMINICAN REPUBLIC: Peto; MARTINIQUE: Thazard raité; MEXICO: Peto; PACIFIC ISLANDS TRUST TERRITORIES: Palau: Keskas, Mersad; Tobi: Yar; Polynesia: Paere, Rorora; PUERTO RICO: Peto; SOUTH AFRICA: Wahoo; USA: Wahoo; Hawaii: Ono; USSR: Korolevskaya makrel; VENEZUELA: Peto, Sierra.

**Literature :** Iversen & Yoshida (1957); Collette (1978, Species Identification Sheets, Western Central Atlantic); Collette (1981, Species Identification Sheets, Eastern Central Atlantic).

**Remarks :** Giant digenetic trematods, tentatively identified as Hirudinella ventricosa, were found in 80.5% of the 885 stomachs of wahoo caught in the southeastern Atlantic and Gulf of Mexico (Manooch & Hogarth, 1983).

**Allothunnus** Serventy, 1948 — SCOMBR Allo

**Genus with reference :** Allothunnus Serventy, 1948:132. Type-species: Allothunnus fallai Serventy, 1948, by monotypy.

**Allothunnus fallai** Serventy, 1948 — SCOMBR Allo 1

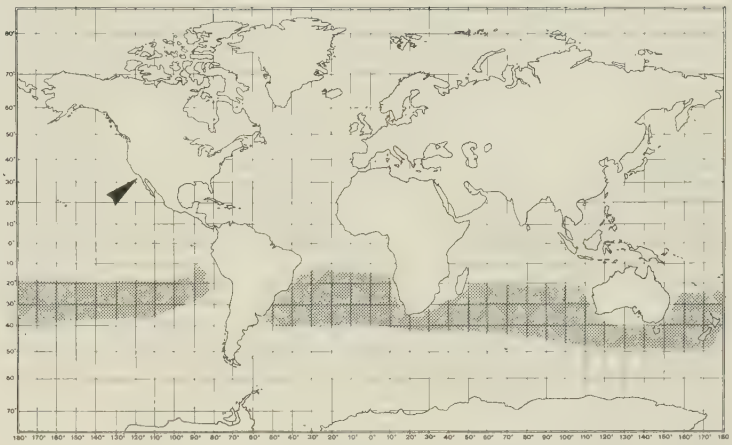
Allothunnus fallai Serventy, 1948:132-135, fig. 1 (South Island, New Zealand).

**Synonymy :** None.

**FAO Names :** En - Slender tuna; Fr - Thon élégant; Sp - Atún lanzón.

**Diagnostic Features :** Body robust, elongate and rounded. Teeth very small and conical, 40 to 55 on each side of upper and lower jaws; 70 to 80 gillrakers on first arch, more than in any other scombrid species. Dorsal fins close together, the first with 15 to 18 spines, the second with 12 or 13 rays, followed by 6 or 7 finlets; anal fin with 13 or 14 rays, followed by 6 or 7 finlets; pectoral fins with 24 to 26 rays; interpelvic process small and bifid. Body naked ventrally behind the long anterior corselet; dorsal half of body to lateral line covered with small scales; caudal peduncle slender with a well developed lateral keel between the 2 smaller keels on each side. Swimbladder absent. Vertebrae 20 precaudal plus 20 caudal, total 40.

**Geographical Distribution :** Circumglobal in the Southern Ocean from 20° to 50°S (Collette & Chao, 1975:fig. 69), except for one individual taken in Los Angeles Harbour (Fitch & Craig, 1964) (see ►).



**Habitat and Biology :** Slender tuna is an epipelagic, probably oceanic species, feeding mainly on krill (euphausids) (Webb & Wolfe, 1974), and also on squids and small fishes. Juveniles are principally encountered between 20 and 35°S at surface temperatures ranging from 19 to 24°C. With increasing size they gradually move into higher latitudes where water temperatures are lower.

**Size :** Maximum size is 96 cm fork length and less than 10 kg weight. Sizes in Japanese longline catches range between 65 and 96 cm. In the southwestern Indian Ocean, the dominant length class is 85 or 86 cm, while smaller fish prevail in the other oceans. The smallest fish showing signs of maturity was a male of 71.5 cm fork length.

**Interest to Fisheries :** At present there is no special fishery for slender tuna, but the species has been taken incidentally south of 38°S by longliners fishing for Thunnus maccoyii (Warashina & Hisada, 1972). However, because of its plankton-feeding behaviour, Allothunnus fallai is less vulnerable to longline gear. On the other hand, purse seiners made catches of 50 and 80 tons of slender tuna off the east coast of Tasmania in June 1974, the fish averaging 9 kg in weight. This is an indication that the species may be more common in these waters (Webb & Wolfe, 1974). The flesh is paler than that of most true tunas and is very oily. Tasmanians agree, however, that the cooked meat has fine eating qualities (Webb & Wolfe, 1974). A Japanese test pack of Allothunnus gave a canned product very similar to high-priced white meat tuna (albacore) even though the raw material fetches a price even lower than that of "second-class" tuna (skipjack) (Klawe, pers.comm.). Hence industrial exploitation of this species is unlikely in the near future.

**Local Names :** JAPAN: Hosokatsuo; SOUTH AFRICA: Slank tuna, Slender tuna; USA: Slender tuna; USSR: Yuzhnij tunets.

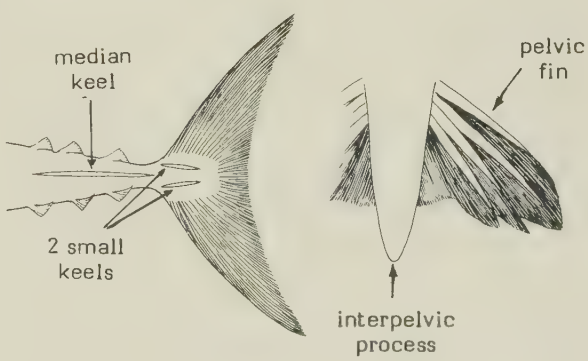
**Literature :** Nakamura & Mori (1966); Warashina & Hisada (1972); Webb & Wolfe (1974); Collette & Chao (1975).

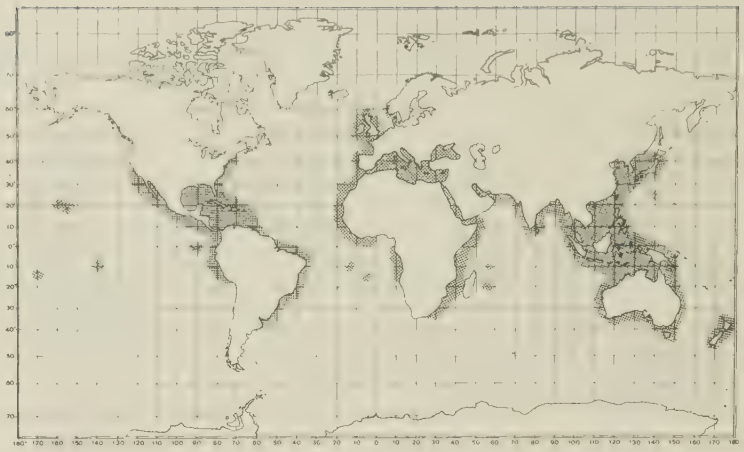
## Auxis Cuvier, 1829

SCOMBR Aux

**Genus with reference :** Auxis Cuvier, 1829:199. Type-species: Scomber rochei Risso, 1810, by subsequent selection of Gill, 1862.

**Diagnostic Features :** Body robust, elongate and rounded. Teeth small and conical, in a single series; two dorsal fins, the first with 10 to 12 spines, separated from the second by a large interspace (at least equal to length of first dorsal fin base), the second fin followed by 8 finlets; pectoral fins short; a large single interpelvic process, longer than the pelvic fins; anal fin followed by 7 finlets. Body naked except for the corselet, which is well developed in its posterior part. A strong central keel on each side of caudal fin base between 2 smaller keels. Swimbladder absent. Vertebrae 20 precaudal plus 19 caudal, total 39. Colour: back bluish, turning to deep purple or almost black on the head; belly white, without stripes or spots; pectoral and pelvic fins purple, their inner sides black.





**Geographical Distribution :** Worldwide in tropical and subtropical waters, including the Mediterranean and the Black Sea.

**Habitat and Biology :** Epipelagic, neritic and oceanic genus in warm waters with strong schooling behaviour. Though larvae have a high temperature tolerance (at least between 21.6° and 30.5°C), the widest among tuna species studied, their optimum temperature is between 27.0° and 27.9°C, and the species is usually confined to oceanic salinities.

From larval records, it is deduced that Auxis spawns throughout its distribution range. In correlation with temperature and other environmental changes, the spawning season varies with areas, but in some places it may even extend throughout the year. Spawning is believed to occur in several batches of up to 1 million eggs.

Food is primarily selected by the size of the gillrakers and consists of fishes, crustaceans, cephalopods and others (see i.e. Uchida, 1981, for a selection). In turn, Auxis are preyed upon primarily by large tunas, billfishes, barracudas, various sharks and others. Cannibalism is widespread. Because of their abundance, they are considered an important element of the food web, particularly as forage for other species of commercial interest (Olson, 1982).

**Interest to Fisheries :** Catches of Auxis are usually not identified to species. In the period from 1978 to 1981 the nominal world catch varied between 75 760 metric tons (1978) and 137 043 metric tons (1980), equivalent to an overall increase in landings over the previous years, but decreased to 108 689 metric tons in 1981 (FAO, 1983). Catches outside the Atlantic were highest in Fishing Areas 61 and 71, with Japan and the Philippines landing 16 287 and 78 248 metric tons respectively in 1981 (FAO, 1983).

Auxis are caught most commonly with pole and line; other commercial and artisanal gear include trolling lines, handlines, small-scale longlines, and a wide variety of nets, including traps, gill or drift nets, ring nets, beach seines, otter trawls, and purse seines. In some of these gears, Auxis are taken incidentally to other species sought. In the purse seine fisheries for yellowfin and skipjack tunas, Auxis, being smaller and hence getting "gilled" in the webbing, are even considered a nuisance.

Both Auxis species are appreciated food fish, but the quality of the meat deteriorates rather rapidly after death. They are canned, flake-dried and smoked.

**Local Names :** ALGERIA: Auxide, Bisu, Melva, Melvara, Scunno; ANGOLA: Jedeu; BRAZIL: Bonito cachorro; BRITISH WEST INDIES: Blowgoat, Frigate mackerel, Round-belly bonito; CANADA: Frigate mackerel, Thazard; COLOMBIA: Atún, Bonito, Cachorreta, Macarela; DENMARK: Auxide; ECUADOR: Botellita; FRANCE: Auxide, Auxide bise, Bizet, Bonitou, Bounitou, Bounicou, Melva, Palamida, Tazard; FRENCH SPEAKING WEST AFRICA: Melva; GHANA: Frigate mackerel, Okpopu, Odaabi, Poku-poku; GREECE: Kopáni; HAITI: Maquereau; INDIA: Choora, Churai, Frigate mackerel; North Malayalam: Kutti-choora; South Malayalam: Urulan-choora; Eli-choorai, Kutteli-choorai (Tamil); INDONESIA: Timpih, Timpik; ISRAEL: Palmida gammadit, Tuna nanasit; ITALY: Biso, Bisu, Culariau, Mazzita, M'pisu, Pisantuni, Sangulu, Scurmo, Sgamiru, Sgionfetta, Strombo, Strumbo, Tambarella, Tambarello, Tamburella, Tombarello, Tumbarel, Tunnacchiu; IVORY COAST: Boku-boku, Bongu, Poku-poku; KENYA: Frigate mackerel, Sehewa (Swahili); KOREA: Mog-man-dung-i, Mul-chi, Mul-chi-da-rae, Mu-tae-da-raeng; MALAYSIA: Sarawak: Tongkol; MALTA: Mazzita, Tombrell, Tombitombi, Zgamirru; MEXICO: Bonito, Melva; MOROCCO: Melva; NETHERLANDS: Valse bonito; NEW ZEALAND: Frigate tuna; NORWAY: Auxis; PACIFIC ISLANDS TRUST TERRITORIES: Chesodm, Keokeo; PAPUA NEW GUINEA: Deho; PERU: Barrilete, Barrilete negro, Fragata, Macarela, Macarela bonito, Melva; PHILIPPINES: Frigate mackerel, Manko, Mangko, Tunungan (Marinao, Samal, Visaya, and Tao sug); PORTUGAL: Bonito, Cachorra, Gayado, Judeu, Serra; Madeira: Chapouto; SENEGAL: Bonite à dos rayé; SEYCHELLES: Bonite folle: SOMALIA: Sehewa (Swahili); Mijurtein coast: Tubani (Somali); SOUTH AFRICA: Boo hoo, Bullet mackerel, Fregat-makriel, Frigate mackerel, Kocëlmakriel; SPAIN: Bis, Bonito del Norte, Macaela, Melva, Melvara, Visol; SRI LANKA: Alagoduwa, Frigate mackerel, Rogodwa (Sinhalese); SURINAME: Blowgoat, Frigate mackerel; SWEDEN: Auxide; TAIWAN, PROVINCE OF CHINA: Chien yu; TANZANIA: Sehewa (Swahili); THAILAND: Pla O; TURKEY: Gobene; UK: Plain bonito; USA: Boo hoo; Hawaii: Keokeo, Mexican skipjack; USSR: Auksida, Makreletunets, Makrelevyj tunets, Skumbrievyi tunets; VENEZUELA: Cabaña negra; VIET NAM: Cá Bò; YUGOSLAVIA: Rumbac, Trupac, Tunjcic.

**Literature :** Wade (1949); Fitch & Roedel (1963); Yoshida & Nakamura (1965); Fischer, ed. (1973, Species Identification Sheets, Mediterranean and Black Sea); Fischer & Whitehead, eds. (1974, Species Identification Sheets, Eastern Indian Ocean/Western Central Pacific); Collette (1978, Species Identification Sheets, Western Central Atlantic ; 1981, Species Identification Sheets, Eastern Central Atlantic); Uchida (1981).

**Remarks :** In the belief that there was only a single worldwide species of Auxis, many authors have used the scientific name A. thazard as including A. rochei. This is reflected in the large number of local names found in the literature for A. thazard, many of which are also in use for A. rochei or should in fact be attributed exclusively to that species as is the case for those names used in the Mediterranean and Black seas, where A. thazard does not occur. For this reason most local names are listed in the generic section. Because of persistent difficulties with species identification and hence, association of distributional records with individual species it appears advisable, for the time being, to refrain from showing separate geographical records for A. rochei and A. thazard. Therefore, the map here included gives the entire distributional range of the genus Auxis.

**Auxis rochei** (Risso, 1810) SCOMBR Aux 2

Scomber rochei Risso, 1810, Ichthyologie Nice:165-167 (Nice).

**Synonymy :** Scomber bisus Rafinesque, 1810; Thunnus rocheanus - Risso, 1826; Auxis vulgaris Cuvier in Cuvier & Valenciennes, 1831; Auxis bisus - Bonaparte, 1845; Auxis thynnoides Bleeker, 1855; Auxis rochei - Günther, 1860; Auxis maru Kishinouye, 1915.

**FAO Names :** En - Bullet tuna; Fr - Bonitou; Sp - Melvera.

**Diagnostic Features :** Pectoral fins short, not reaching vertical line from anterior margin of scaleless area above corselet; corselet well developed in its posterior part (more than 6 scales wide, usually 10 to 15) under second dorsal fin origin). Colour: a pattern of 15 or more fairly broad, nearly vertical dark bars in the scaleless area.

**Geographical Distribution :** Cosmopolitan in warm waters. See distribution map in generic section.

**Habitat and Biology :** An epipelagic, neritic as well as oceanic species. The spawning season may vary from region to region depending on the hydrographical regime: in many parts of the Mediterranean and in the Straits of Gibraltar, maturing fish are common from May onwards, and more than 30% are spent by September. In large areas of the Gulf of Mexico, peaks of batch spawning are reported from March to April and from June to August, while in the coastal waters from Cape Hatteras to Cuba and in the Straits of Florida, the spawning season begins in February. Indirect evidence suggests that the season extends at least from June through July off Taiwan Island and from May through August off southern Japan as indicated by gonad indexes and larval counts respectively. Silas (1969) estimated fecundity as ranging between 31 000 and 103 000 eggs per spawning according to the size of the fish. Food consists largely of small fishes, particularly anchovies and other clupeoids (Etchevers, 1957). For further information on the biology of this species see generic section on Auxis.

**Size :** Maximum fork length is 50 cm in Japanese catches, common to 35 cm. Common fork lengths in the Indian Ocean range between 15 and 25 cm (Silas & Pillai, 1982). Fork length at first maturity off Gibraltar is 35 cm in females and 36.5 cm in males (Rodriguez-Roda, 1966).

**Interest to Fisheries :** Catches of Auxis are usually not identified to species. However, almost the entire Atlantic and Mediterranean catch is supposedly A. rochei. Between 1977 and 1981, 14 countries reported catches of Auxis from Fishing Areas 21, 27, 31, 34 and 47. The highest catches were reported by Ghana, Italy, Spain and Venezuela (FAO, 1983).

**Local Names :** AUSTRALIA: Long corseletted frigate mackerel, Maru frigate mackerel; JAPAN: Chiboh, Dainanpo, Magatsuwo, Manba, Mandara, Marugatsuwo, Marumejika, Marusöda, Marusödakatsuo, Mejika, Nodoguro, Rohsoku, Soda, Soku, Subo, Subota, Uzawa. (Dainanbo, Marumedika, Marugatsuo, and Magatsuo are variations in spelling of some of the above names.) Other names mentioned by Rosa (1950) are kobukura, Kogatsuo, Kubarai; USA: Bullet mackerel, Bullet tuna.

**Literature :** Collignon (1961); Jones (1963); Fitch & Roedel (1963); Fischer & Whitehead, eds (Species Identification Sheets, Eastern Indian Ocean/Western Central Pacific; Collette (1978, Species Identification Sheets, Western Central Atlantic; 1981, Species Identification Sheets, Eastern Central Atlantic); Uchida (1981).

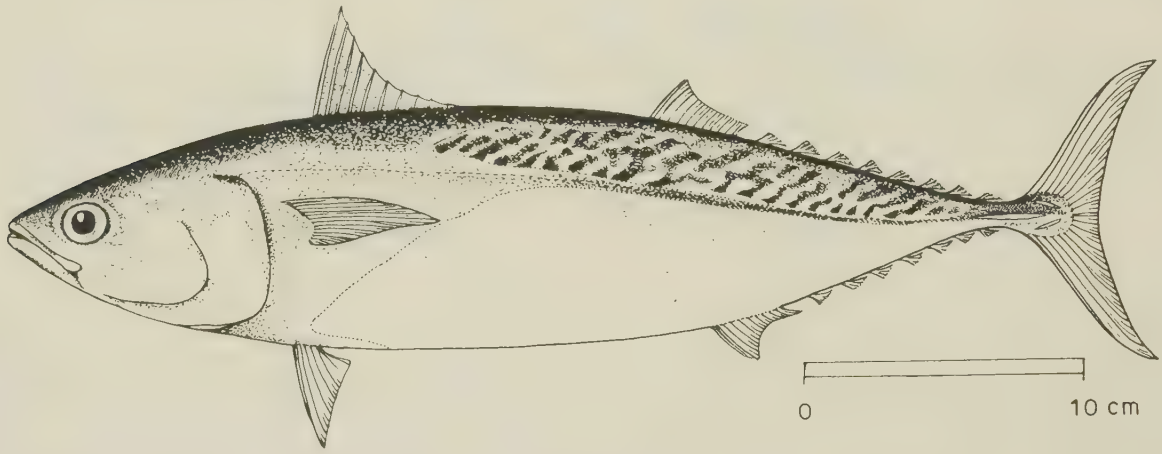
**Remarks :** For other local names and remarks see generic section.

**Auxis thazard** (Lacepède, 1800) SCOMBR Aux 1

Scomber thazard Lacepède, 1800, Histoire Naturelle des Poissons, 2:599 (New Guinea).

**Synonymy :** Auxis taso Commerson in Cuvier & Valenciennes, 1831; Auxis tapeinosoma Bleeker, 1854; Auxis thazard - Dresslar & Fesler, 1889; Auxis hira Kishinouye, 1915. In the belief that there was only a single worldwide species of Auxis, many authors have used the name A. thazard as including A. rochei.

**FAO Names :** En - Frigate tuna; Fr - Auxide; Sp - Melva.




**Diagnostic Features :** Pectoral fins short, but reaching past vertical line from anterior margin of scaleless area above corselet: corselet well developed and narrow in its posterior part (no more than 5 scales wide under second dorsal fin origin). Colour: a pattern of 15 or more narrow, oblique to nearly horizontal, dark wavy lines in the scaleless area above lateral line.

**Geographical Distribution :** Probably cosmopolitan in warm waters but there are only a few documented occurrences in the Atlantic Ocean. See distribution map in generic section.

**Habitat and Biology :** An epipelagic, neritic as well as oceanic species. In the eastern Pacific, mature fish occur throughout the year, though off Costa Rica spawning is heaviest from December through April, while in Japanese waters it peaks in July as expressed by the index of sexual maturity (Yasui, 1975). In the southern Indian Ocean, the spawning season extends from August to April; north of the equator it is reported from January to April. Fecundity was estimated at about 1.37 million eggs per year in a 44.2 cm long female. Fecundity of fish in Indian waters ranged between approximately 200 000 to 1.06 million eggs per spawning in correlation with size of females. For other pertinent information on the biology see generic section on Auxis.

**Size :** Maximum fork length from driftnet records in the Indian Ocean is 51 cm, but off Sri Lanka it is 58 cm; the common size in catches ranges between 25 and 40 cm, but depends on the type of gear used, and may also vary seasonally and by region. Size at first maturity is reported at about 29 cm fork length in Japanese waters, but about 35 cm around Hawaii. The species grows larger than A. rochei.

**Interest to Fisheries :** Catches of Auxis are usually not identified to species because of current problems in identification. It may, however, be assumed that the Pacific and Indian Ocean catches reported by Japan, the Philippines and the Maldives are predominantly A. thazard. In the period from 1977 to 1980 these catches almost doubled to 122 995 metric tons, particularly due to increased landings by the Philippines, but decreased to about 98 000 metric tons 1981 (FAO, 1983).

**Local Names :** AUSTRALIA: Frigate mackerel, Leadenall; JAPAN: Hiramejika, Hirasoda, Hirasodakatsuo, Oboso, Obosogatsuwo, Shibuwa, Soma, Suma (Hirasohda, Hiragatsuo, and Hiramedika are variations in spelling of some of the above names); USA: Bullet mackerel, Frigate mackerel, Frigate tuna.

**Literature :** Fitch & Roedel (1963); Fischer & Whitehead, eds (1974, Species Identification Sheets, Eastern Indian Ocean/Western Central Pacific); Collette (1978, Species Identification Sheets, Western Central Atlantic; 1981, Species Identification Sheets, Eastern Central Atlantic); Uchida (1981).

**Remarks :** For other local names and remarks see generic section.

**Cybiosarda** Whitley, 1935 — SCOMBR Cybio

**Genus with reference :** Cybiosarda Whitley, 1935:236. Type-species: Scomberomorus (Cybiosarda) elegans Whitley, 1935, by monotypy.

**Cybiosarda elegans** (Whitley, 1935) — SCOMBR Cybio 1

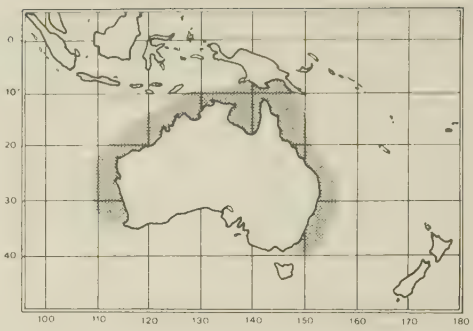
Scomberomorus (Cybiosarda) elegans Whitley, 1935, Rec.Austral.Mus., 19:236-237 (Moreton Bay, Queensland).

**Synonymy :** Cybiosarda elegans - Whitley, 1936; Gymnosarda elegans - Fraser-Brunner, 1950.

FAO Names : En - Leaping bonito; Fr - Bonite à dos tacheté; Sp - Bonito saltador.

**Diagnostic Features :** Body relatively short and deep, strongly compressed. Mouth rather large, upper jaw reaching to hind margin of eye; 2 tooth patches on upper surface of tongue; 13 to 22 large, conical teeth on upper jaw, 10 to 17 on lower jaw; 12 to 15 gillrakers on first arch; laminae of olfactory rosette 28 to 33; interorbital width 23.9 to 31% of head length. Dorsal fins close together, the first high anteriorly, with 16 to 18 spines; the second with 17 to 19 rays followed by 8 to 10 finlets; anal fin with 15 to 17 rays followed by 6 or 7 finlets; pectoral fins short with 22 to 24 rays; interpelvic process small and bifid. Body mostly naked behind the well developed corselet except for a band of scales along the bases of dorsal and anal fins and patches of scales around the bases of the pectoral and pelvic fins; caudal peduncle slender, with a well developed lateral keel between two smaller keels on each side. Swimbladder absent, spleen not visible in ventral view, concealed under liver; liver with an elongate right lobe and a short left lobe which tends to fuse with the middle lobe. Vertebrae 22 to 24 precaudal plus 23 to 26 caudal, total 47 or 48. Colour: belly light with several stripes reminiscent of those of the skipjack tuna, Katsuwonus pelamis; back deep blue covered with elongate black spots; first dorsal fin jet black anteriorly, white in the few last posterior membranes; anal and second dorsal fins yellow.

**Geographical Distribution :** Restricted to the northern three quarters of Australia (Collette & Chao, 1975:fig.69) plus the southern coast of Papua New Guinea.



**Habitat and Biology :** An epipelagic, neritic species forming schools of several hundred individuals. No information is available on its biology.

**Size :** Common fork length ranges between 35 and 45 cm with a weight of about 2 kg.

**Interest to Fisheries :** Leaping bonito lacks commercial importance in Queensland but is taken as bait for snappers by commercial fishermen, and for marlins and sharks by sports fishermen (Grant, 1982:641). The meat is white and dry; suitable for human consumption, particularly when smoked or served steamed with moderately flavoured white sauce.

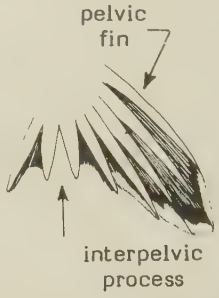
**Local Names :** AUSTRALIA: Leaping bonito, Watson's bonito; USSR: Tsibiosarda.

**Literature :** Whitley (1936); Collette & Chao (1975); Grant (1982).

## Euthynnus Lütken, 1882

SCOMBR Euth

**Genus with reference :** Euthynnus Lütken in Jordan and Gilbert, 1882:429. Type-species Thynnus thunnina Cuvier, 1831 (= Scomber alletteratus Rafinesque, 1810), by original designation.




**Diagnostic Features :** A medium-sized fish with a robust, elongate and fusiform body. Teeth small and conical, in a single series; about 25 to 35 on each side of lower jaw; palatine teeth present; gillrakers 29 to 45 on first arch; gill teeth 28 to 32 on posterior surface of first gill arch. Two dorsal fins, the first with 10 to 15 spines; both fins separated by only a narrow interspace (not wider than eye), anterior spines of first much higher than those mid-way, giving the fin a strongly concave outline; second dorsal fin much lower than first and followed by 8 to 10 finlets; pectoral fins short: 25 to 29 rays; never reaching the interspace between the dorsal fins; interpelvic process small and bifid; anal fin with 11 to 15 rays, followed by 6 to 8 finlets. Body naked except for corselet and lateral line. A very slender caudal peduncle with a prominent lateral keel between 2 small keels at base of caudal fin. Swimbladder absent. Vertebrae 37 to 39. Colour: back dark blue or irridescent green in one species with a complicated striped pattern which does not extend forward beyond middle of first dorsal fin; lower sides and belly silvery white without dark longitudinal stripes; several characteristic dark spots between pelvic and pectoral fins (which, however, may not always be very conspicuous).

**Geographical Distribution :** Worldwide in tropical and subtropical, primarily coastal waters; the geographical distribution of the three species is complementary, with hardly any overlap.

**Habitat and Biology:** An epipelagic, primarily neritic genus, rarely encountered in waters where surface temperatures fall below 20° to 23°C. Spawning occurs in batches when the water is warmest. Schooling by size occurs primarily with other scombrid species, but this behaviour is less developed than in Auxis, and during certain periods of the year, there is a tendency to scatter.

Euthynnus species are highly opportunistic predators feeding on fish, crustaceans, squids, tunicates and other forage. They compete for food with other species they school with, but probably also with dolphins and cetaceans. They are preyed upon by large yellowfin tuna, marlins and sharks.

**Interest to Fisheries :** The world catch of Euthynnus fluctuated between about 66 000 metric tons in 1975 and 78 000 metric tons in 1981, hitting some 90 000 metric tons in 1977 (FAO, 1983). Most of this was E. affinis, with the Philippines, Malaysia taking the highest catches. Typically, fishing operations are not exclusively directed at this genus, but take Euthynnus together with other scombrids in drift (gill) nets, on hook-and-line, purse seines, with trolling lines and a number of artisanal gears such as beach seines, specialized traps, set nets, etc.

**Literature :** Fraser-Brunner (1949); Godsil (1954); Yoshida (1979).

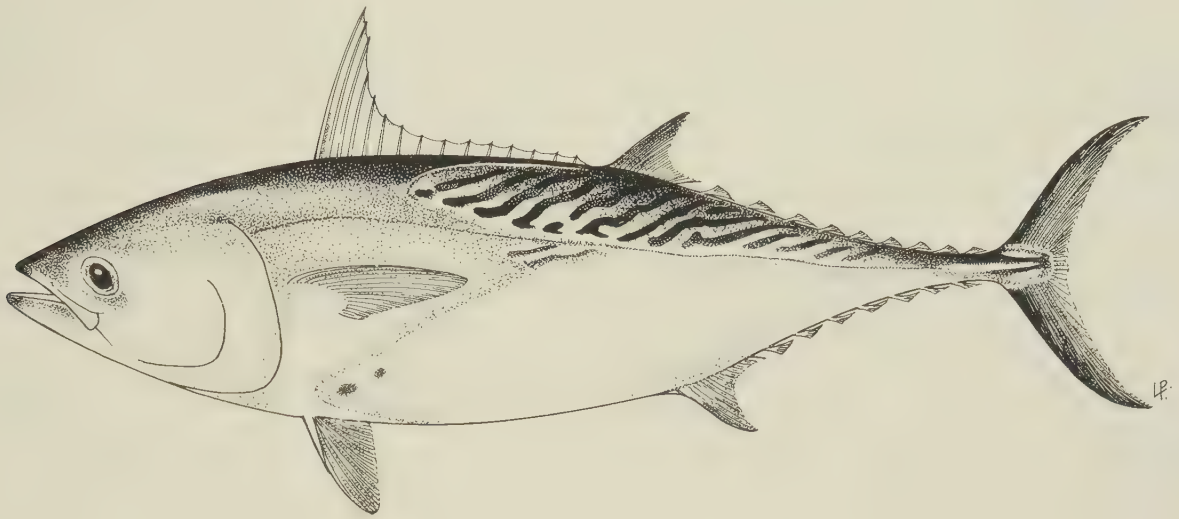
**Euthynnus affinis** (Cantor, 1849)

SCOMBR Euth 2

Thynnus affinis Cantor, 1849, J.Asiatic Soc.Bengal, 18(2):1088-1090 (Sea of Penang, Malaysia).

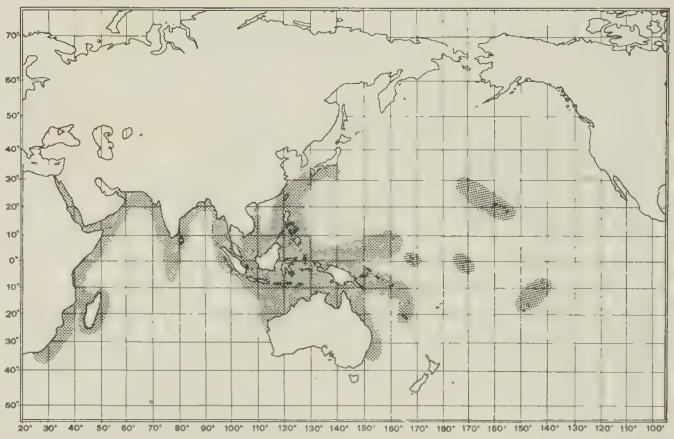
**Synonymy :** Euthunnus yaito Kishinouye, 1915; Wanderer wallisi Whitley, 1937; Euthunnus affinis affinis - Fraser-Brunner, 1949; Euthunnus affinis yaito - Fraser-Brunner, 1949; Euthunnus alletteratus affinis - Beaufort, 1951; Euthunnus wallisi - Whitley, 1964.

**FAO Names :** En - Kawakawa; Fr - Thonine orientale; Sp - Bacoreta oriental.



**Diagnostic Features :** Gillrakers 29 to 33 on first arch; gill teeth 28 or 29; vomerine teeth absent. Anal fin rays 13 or 14. Vertebrae 39; no trace of vertebral protuberances; bony caudal keels on 33rd and 34th vertebrae. Colour: dorsal markings composed of broken oblique stripes.

**Geographical Distribution :** Throughout the warm waters of the Indo-West Pacific, including oceanic islands and archipelagos. A few stray specimens have been collected in the eastern tropical Pacific.



**Habitat and Biology :** An epipelagic, neritic species inhabiting waters temperatures ranging from 18° to 29°C.

Like other scombrids, E. affinis tend to form multispecies schools by size, i.e. with small Thunnus albacares, Katsuwonus pelamis, Auxis sp., and Megalaspis cordyla (a carangid), comprising from 100 to over 5 000 individuals.

Although sexually mature fish may be encountered throughout the year, there are seasonal spawning peaks varying according to regions: i.e. March to May in Philippine waters; during the period of the NW monsoon (October-November to April-May) around the Seychelles; from the middle of the NW monsoon period to the beginning of the SE monsoon (January to July) off East Africa; and probably from August to October off Indonesia. The only available information on fecundity applies to Indian Ocean material: a 1.4 kg female (ca 48 cm fork length) spawns approximately 0.21 million eggs per batch (corresponding to about 0.79 million per season), whereas a female weighing 4.6 kg (65 cm fork length) may spawn some 0.68 million eggs per batch (2.5 million per season). The sex ratio in immature fish is about 1:1, while males predominate in the adult stages.

E. affinis is a highly opportunistic predator feeding indiscriminately on fish, shrimps and cephalopods. In turn, it is preyed upon by marlins and sharks.

**Size :** Maximum fork length is about 100 cm and weight about 13.6 kg, common to 60 cm. The all-tackle angling record is a 11.80 kg fish from Merimbala, New South Wales, with a fork length of 96.5 cm taken in 1980. In Philippines waters, maturity is attained at about 40 cm fork length, while in the Indian Ocean it is reached between 50 and 65 cm in the 3rd year of age.

**Interest to Fisheries :** The reported world catch (eight countries) for the period between 1975 and 1981 fluctuated between about 44 000 and 65 000 metric tons per year. The 1977 catches were exceptionally high, almost 84 000 metric tons. About 67 500 metric tons were reported for 1981 (FAO, 1983). The countries with the largest landings were the Philippines, Malaysia and Pakistan. In India, E. affinis is an important species in local drift net (gillnet) and hook-and-line fisheries, even though this country has not supplied separate statistics for it during the above period. Typically these are multispecies fisheries also taking E. affinis. Besides gillnetting, trolling is the major fishing technique in use. Occasionally beach seines and longlines are also deployed. Some gear types are rather size-selective, i.e. trolling lines take smaller fish than gillnets. The meat is of good quality when fresh, but it deteriorates very fast if not treated adequately.

**Local Names :** AUSTRALIA: Bonito, Little tuna, Mackerel tuna; CHINA: Tow chung; COMOROS: Bonito, Mibassi, Mpassi; INDIA: Choori-min, Suraly (Tamil); Chuki, Ohaman (Marathi); INDONESIA: Diverg-bonito, Poetilai, Tongkol, Tongkol komo; JAPAN: Hiragatsuo, Obosogatsuo, Segatsuo, Suma, Sumagatsuo, Watanabe, Yaito; KENYA: Bonito, Little tuna, Sehewa (Swahili); MADAGASCAR: Bonite, Thonnine; MALAYSIA: Choreng, Ikanayer, Kembel-mas, Sembak, Tombal-mas (Malay); Tongkol; MAURITIUS: Bonite, Bonito; PACIFIC ISLANDS TRUST TERRITORIES: Micronesia: Chesodm; Polynesia: Otava; PAPUA NEW GUINEA: Kababida; PAKISTAN: Chooki, Dawan, Dwarf bonito, Jukko; PHILIPPINES: Katsarita, Oceanic bonito, Tulingan, Yaito bonito; SEYCHELLES: Bonite, Bonito, Little tunny; SOMALIA: Jeidha, Maba'di (Somali); SOUTH AFRICA: Eastern little tuna, Oostelike kleintuna; SRI LANKA: Atavalla, Lesser bonito, Mackerel tuna, Ragodura, Sureya (Sinhalese), Shurai (Tamil); TANZANIA: Bonito, Little tuna, Sehewa (Swahili); USA: Bonito, Kawakawa, Little tuna; USSR: Malyj tunets, Pyatinstyj indo-tikhookeanskyj tunets; VIET NAM: Cá ngừr, Dài-loan.

**Literature :** Kishinouye (1923); Kikawa et al. (1963); Williams (1963); Fischer & Whitehead, eds (1974, Species Identification Sheets, Eastern Indian Ocean/Western Central Pacific); Yoshida (1979).

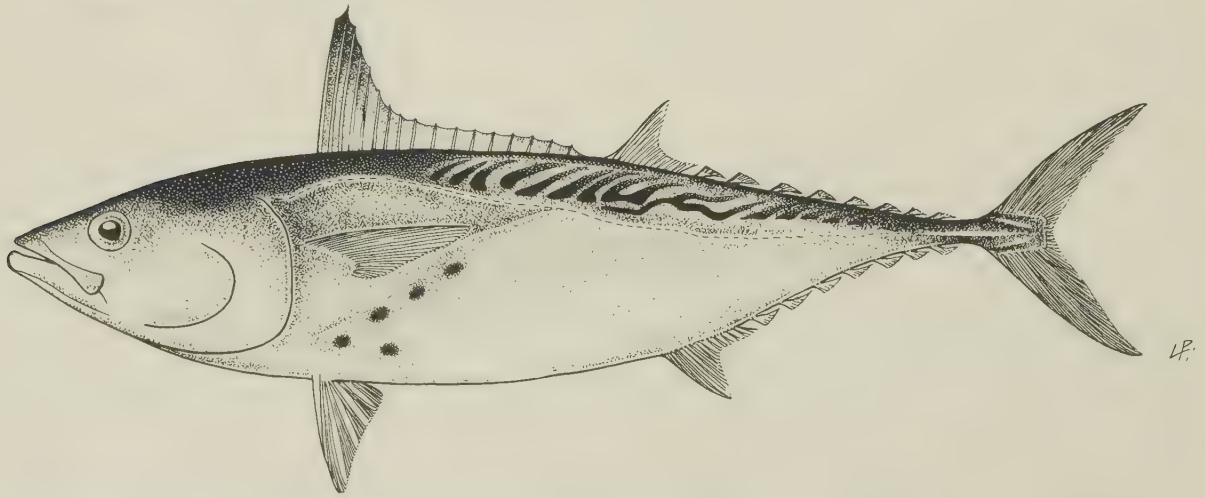
**Remarks :** The East African Swahili vernacular name "Sehewa" is also in use for skipjack (Katsuwonus pelamis) and Auxis species; the Somalian name "Jeidha" likewise refers to small yellowfin tuna (Thunnus albacares) and hardtail scad (Megalaspis cordyla). Names like 'Little tuna', 'Little tunny', 'Black skipjack', and 'Mackerel tuna' are used indiscriminately for this as well as other species of the genus Euthynnus in some countries.

**Euthynnus alletteratus** (Rafinesque, 1810) | SCOMBR Euth 1

Scomber alletteratus Rafinesque, 1810, Caratteri Generi Specie Sicilia:46, pl. 2 (fig. 3) (Sicily).

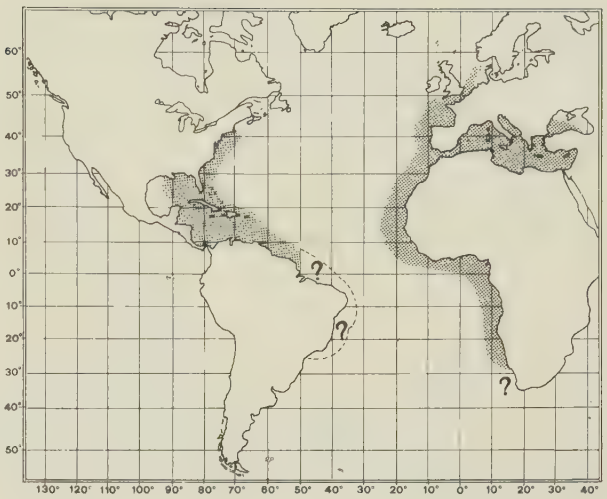
**Synonymy :** Scomber quadripunctatus E. Geoffrey St. Hilaire, 1817; Thynnus leachianus Risso, 1826; Thynnus thunina Cuvier, 1829; Thynnus thunnina - Cuvier in Cuvier & Valenciennes, 1831; Thynnus brasiliensis Cuvier in Cuvier & Valenciennes, 1831; Thynnus brevipinnis Cuvier in Cuvier & Valenciennes, 1831; Orcynus thunnina - Poey, 1875; Thynnichthys thunnina - Giglioli, 1880; Thynnichthys brevipinnis - Giglioli, 1880; Euthynnus alliteratus - Jordan & Gilbert, 1882; Gymnosarda alletterata - Dresslar & Fesler, 1889; Euthynnus thunnina - Carus, 1893; Pelamys alleterata - Fowler, 1905; Euthynnus allitteratus - Ehrenbaum, 1924; Euthynnus alleteratus - Chabanaud, 1925; Gymnosarda alleterata - Chabanaud & Monod, 1927; Euthynnus alletteratus - De Buen, 1930; Euthynnus alletteratus alletteratus - Fraser-Brunner, 1949; Euthynnus alletteratus aurolitoralis Fraser-Brunner, 1949; Euthynnus quadripunctatus Postel, 1973.

**FAO Names :** En - Little tunny; Fr - Thonine commune; Sp - Bacoreta.



**Diagnostic Features :** Gillrakers 37 to 45 on first arch; gill teeth 31 or 32; vomerine teeth absent. Anal fin rays 11 to 15. Vertebrae 39; incipient protuberances on 33rd and 34th vertebrae; bony caudal keels on 33rd and 34th vertebrae. Colour: dorsal markings composed of broken horizontal stripes or bars.

**Geographical Distribution :** Tropical and subtropical waters of the Atlantic Ocean including the Mediterranean, Black Sea, Caribbean Sea, and Gulf of Mexico.




**Habitat and Biology :** An epipelagic, neritic species, typically occurring in inshore waters. E. alletteratus school by size together with other scombrid species, but have a tendency to scatter during certain periods of the year.

In the Mediterranean, spawning occurs from late spring through summer, whereas it extends from about April to November in the eastern and western Atlantic. Eggs are shed in several batches when the water is warmest. Little is known about fecundity, but examination of a single, 75 cm long female off Senegal yielded about 1.75 million eggs. In the juvenile stages, the sex ratio is approximately 1:1, whereas in the mature phase males predominate in the catches.

Little tunny is an opportunistic predator feeding on virtually everything within its range, i.e. crustaceans, fishes, squids, heteropods and tunicates. Clupeoid fishes are particularly important food components (Etchevers, 1976; Menezes & Aragao, 1980). It competes for food with the species it schools with, but probably also with dolphins and other cetaceans. It is in turn preyed upon, among others, by sharks, large yellowfin tuna and billfishes. Growth estimates off Senegal suggest that little tunny in that area grow to almost 30 cm length in their first year, and that fish exceeding 75 cm fork length are older than 4 years.

**Size :** Maximum size in the Mediterranean is about 100 cm fork length and about 12 kg weight; in the tropical eastern Atlantic, little tunny grow to around 90 cm; the all-tackle angling record is a 12.2 kg fish taken off Key Largo, Florida, with a fork length of 92.7 cm. Maturity is reached at a length of about 57 cm off southern Spain, 40 cm off Senegal, 45 cm in the Gulf of Guinea, and 35 cm off Florida. Size of little tunny in commercial catches ranges roughly from 30 to 80 cm fork length.

**Interest to Fisheries :** E. alletteratus is taken in multispecies fisheries along with other species of tunas and bonitos. Specialized traps (madragues) are used in Tunisia and Morocco, and beach seines in Senegal, Ivory Coast, Ghana and Angola (Yoshida, 1979). In the period between 1975 and 1981, catches of little tunny were recorded from 18 countries in 5 fishing areas. World catches fluctuated between 3 103 (in 1977) and 10 731 metric tons (in 1981) (FAO, 1983). The largest reported landings of this species were made by Venezuela (289 to 797 metric tons per year) in Fishing Area 31; by Ghana (54 to 6 049 metric tons, stabilizing between 5 000 and 6 000 metric tons in recent years), Ivory Coast (38 to 860 tons, but recently reporting low catches between 50 and 200 tons) and Mauritania (estimated by FAO at about 1 000 metric tons) in Fishing Area 34; Spain (781 to 1 222 tons) in Fishing Area 37; and Angola (10 to 1 328 tons) in Fishing Area 47. The present catch could probably be increased if the species were in higher demand.

**Local Names :** ANGOLA: Merma; CUBA: Bonito, Comevíveres; DOMINICAN REPUBLIC: Bonito; EGYPT: Tunna; FRANCE: Thonine; GHANA: El'la (Apollonien), Poponkou (Keta); GREECE: Karvouni; GUINEA: Makreni; ISRAEL: Tunnit atlantit; ITALY: Tonnetto; IVORY COAST: Bokou-bokou (Alladian), Bonita, Klewe (Kru); MALTA: Kubrita; MARTINIQUE: Bonite queue raide, Thonine; MAURITANIA: Corrinelo (Vermeulen); MEXICO: Bonito; MONACO: Tunina; MOROCCO: Lbakoura; PORTUGAL: Atún, Fule-fule; PUERTO RICO: Bonito; SENEGAL: Thonine (French); Walas (Lebou); SOUTH AFRICA: Atlantic little tuna, Atlantiese kleintuna, Merma; SPAIN: Bacoreta; TUNISIA: R'zem, Toun-sghir; TURKEY: Yaziliorkinos; USA: False albacore, Little tunny; USSR: Atlanticheskyj malyj tunets, Malyj tunets, Tsyatnystyj atlanticheskyj tunets; VENEZUELA: Atuncito, Bonito, Cabaña pintada, Carachana; YUGOSLAVIA: Luc.

**Literature :** Postel (1955, eastern Atlantic); De Sylva & Rathjen (1961, southeastern USA); Marchal (1963a, eastern Atlantic); Fischer, ed. (1973, Species Identification Sheets, Mediterranean and Black Sea); Collette (1978, Species Identification Sheets, Western Central Atlantic; 1981, Species Identification Sheets, Eastern Central Atlantic); Yoshida (1979); Menezes & Aragao (1980, Brazil).

**Remarks :** Vernacular names like 'Little tuna', 'Little tunny', and 'Black skipjack' may also be in use for other Euthynnus species in some countries.

**Euthynnus lineatus** Kishinouye, 1920

SCOMBR Euth 3

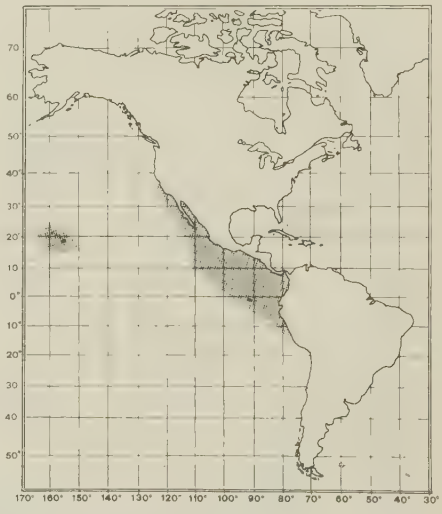
Euthynnus lineatus Kishinouye, 1920, Suisan Gakkai Ho 3(2):113 (Mexico).

**Synonymy :** Euthynnus affinis lineatus - Fraser-Brunner, 1949.

**FAO Names :** En - Black skipjack; Fr - Thonine noire; Sp - Barrilete negro.

**Diagnostic Features :** Gillrakers on first gill arch 33 to 39, gill teeth 29 to 31; vomerine teeth (on roof of mouth) present. Anal fin rays 11 or 12. Vertebrae 37; 4 large rounded protuberances on 31st and 32nd vertebrae; bony caudal keels on 31st and 32nd vertebrae. Colour: iridescent blue with black dorsal markings composed of 3 to 5 continuous horizontal stripes; variable black or dark grey spots above pelvic fins; occasionally extensive longitudinal stripes of light grey on belly; some individuals have few or no belly markings.

**Geographical Distribution :** Waters of the eastern tropical Pacific from off San Simeon, California (35°20'N, 121°40'W) southwards to the Galapagos Islands and northern Peru (Calkins & Klawe, 1963:fig. 2). Also, two stray specimens have been collected in the Hawaiian Islands.



**Habitat and Biology :** An epipelagic, neritic as well as oceanic species rarely occurring where surface temperatures are below 23°C. Larvae are more frequently encountered at temperatures above 26°C and are practically confined to waters within about 240 miles off the mainland.

Like other tuna, black skipjack tend to school by size; they frequently form multispecies schools with Thunnus albacares and Katsuwonus pelamis.

Differential abundance of this species by seasons and area suggests a pattern of north-south migrations, which are not yet fully understood. In the first quarter of the year black skipjack are often encountered off Central America and northwards to the tip of Baja California. In the second quarter they are more abundant in the northern part of this range; in the third quarter the majority of records come from western Baja California; in the fourth quarter, catch records scatter from Baja California to northern Peru.

Spawning off western Baja California is limited to the summer months, while in the mouth of the Gulf of California it peaks from October to December. Larvae are encountered off Costa Rica throughout the year but the peak of spawning appears to occur from March to April. No fecundity estimate is available.

E. lineatus share the opportunistic feeding pattern with other tunas and probably compete for food with other species such as yellowfin tuna, skipjack tuna, oriental bonito, and common dolphinfish (Coryphaena hippurus). Its most important predators include yellowfin tuna, striped marlin (Tetrapturus audax), Atlantic blue marlin (Makaira nigricans), sailfish (Istiophorus platypterus) and sharks.

**Size :** Maximum size in commercial catches is at least 65 cm fork length (range 30 to 65 cm) and 4.9 kg (range 0.5 to 4.9 kg). The all-tackle angling record is a 9.12 kg fish taken off Clarion Island, Mexico, in 1982. Its fork length was 84 cm.

**Interest to Fisheries :** There is no specific fishery for E. lineatus, but the species is taken incidentally by tuna purse seines, live-bait pole-and-line gear, trolling, and sports fishing gear (Calkins & Klawe, 1963:145). In Ecuador and Peru it is also taken by canoe and raft fishermen. Most fish landed are sold fresh in Latin American local markets. Yearly catches in the eastern Pacific totalled around 1 500 metric tons during the seventies; the minimum catch was recorded in 1975 (531 tons), the maximum in 1974 (3 742 tons) (I-ATTC, 1980). The flesh of this species is very dark as compared to other scombrids.

**Local Names :** COLOMBIA: Bonito, Patiseca; ECUADOR: Bonito negro, Negra, Pata seca; MEXICO: Barrilete negro, Negra; PANAMA: Barrilete negro; PERU: Barrilete negro, Macarela; USA: Black skipjack.

**Literature :** Calkins & Klawe (1963); Godsil (1954); Yoshida (1979); Muhlia-Melo (1980).

**Gasterochisma** Richardson, 1845 — SCOMBR Gast

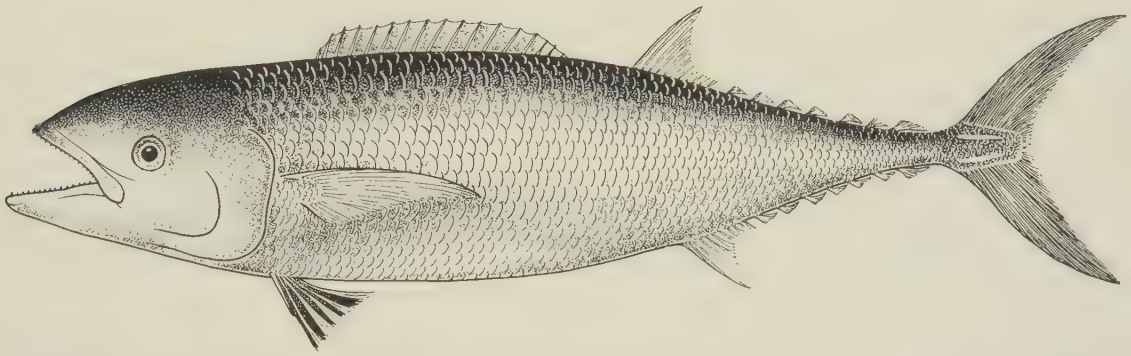
**Genus with reference :** Gasterochisma Richardson, 1845. Type-species Gasterochisma melampus Richardson, 1845, by monotypy.

**Gasterochisma melampus** Richardson, 1845 — SCOMBR Gast 1

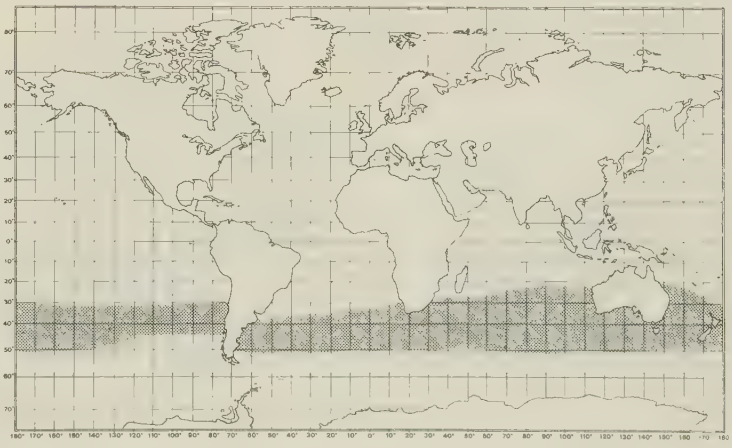
Gasterochisma melampus Richardson, 1845, Ann.Mag.Nat.Hist., 15:346 (Port Nicholson, New Zealand).

**Synonymy :** Lepidothynnus huttoni Günther, 1889; Chenogaster holmbergi Lahille, 1903.

**FAO Names :** En - Butterfly kingfish; Fr - Thon papillon; Sp - Atún chauchera.



**Diagnostic Features :** Body compressed, its depth about 3.5 times in fork length. Teeth small and conical, in a single series; gillrakers 25 on first gill arch. Two dorsal fins separated by a wide interspace in adults, the first with 17 spines, the second with 10 or 11 rays followed by 6 or 7 finlets; anal fin with about 12 rays, also followed by 6 or 7 finlets; pectoral fins short, with 19 to 22 rays; pelvic fins enormous in juveniles, longer than head length, becoming of more normal proportions for scombrids in adults; pelvic fins fitting into a deep ventral groove at all sizes; interpelvic process tiny and bifid. Body covered with large, cycloid scales; no anterior corselet; caudal peduncle with only two small keels on each side, no lateral keel present. Swimbladder present, with 2 anterior projections that extend into the back of the skull. Vertebrae 21 precaudal plus 23 caudal, total 44. Colour: deep bluish above, silvery below, without spots, stripes or other prominent markings.



**Geographical Distribution :** Circumglobal in southern temperate waters, mostly between 35° to 50°S.

**Habitat and Biology :** An epipelagic, oceanic species, sharing the geographical distribution with the southern bluefin tuna. Butterfly kingfish are most abundant in waters of 8° to 10°C. North of the southern polar front or antarctic divergence (that is, at surface temperatures of about 11.5° and above in the southern winter, and 14.5°C in the southern summer), abundance at least of adult butterfly kingfish decreases sharply.

There seems to be a pattern of seasonal north-south migrations similar to that of southern bluefin tuna. The biology of the species is poorly known.

**Size :** Maximum fork length is at least 164 cm. Sizes in the Japanese longline fishery range between 74 and 164 cm. Large-sized fish over 110 cm dominate on the fishing grounds in the western parts of the Atlantic, Pacific and Indian oceans, while smaller fish are more abundant on the eastern fishing grounds.

**Interest to Fisheries :** This species is not of high commercial significance but taken as bycatch by Japanese longliners fishing for Thunnus maccoyii. It occurs on all fishing grounds south of 35°S and in the southeastern Indian Ocean as far north as 26°S. The average catch in terms of number of fish per operation is higher from March to May as compared with other times of the year (Warashina & Hisada, 1972).

**Local Names :** AUSTRALIA: Big-scaled mackerel, Butterfly mackerel; CHILE: Pez chauchera; JAPAN: Urokomaguro; NEW ZEALAND: Scaled tunny; SOUTH AFRICA: Bigscale mackerel, Grootskub-makriel; USSR: Gasterochisma.

**Literature :** Lahille (1905); Warashina & Hisada (1972).

## Grammatorcynus Gill, 1862

SCOMBR Gram

**Genus with reference :** Grammatorcynus Gill, 1862:125. Type-species Thynnus bilineatus Rüppell, 1836, by original designation.

**Diagnostic Features :** Body elongate, slightly compressed. Mouth relatively small, upper jaw reaching about to middle of eye; about 20 to 30 slender conical teeth in upper and lower jaws; patches of fine teeth on palatines and vomer; a rectangular patch of small, sharp teeth on tongue; 14 to 24 gillrakers on first gill arch. Dorsal fins close together, the first with 11 to 13 spines, usually 12, its margin almost straight; the second with 10 to 12 rays followed by 6 or 7 finlets; anal fin with 11 to 13 rays followed by 6 or 7 finlets; pectoral fins stout, with 22 to 26 rays; interpelvic process short and single. Two lateral lines, the first extending from the opercle to the lateral caudal keel, in the usual position for scombrid lateral lines; the second branches off from the first under the third spine of the first dorsal fin, descends below the level of the pectoral fin and runs posteriorly to join with the first at about the level of the last dorsal finlet. Body covered with moderately small scales; no prominent anterior corselet present; caudal peduncle slender, with a well developed lateral keel between the two smaller ones on each side. Swimbladder present. Vertebrae 14 precaudal plus 17 caudal, total 31 as in the mackerels (Scomber and Rastrelliger). Colour: back and upper sides metallic blue-green, belly silvery white with a golden tinge.

**Habitat and Biology :** The two species of Grammatorcynus are epipelagic fishes found mostly in shallow reef waters. Food includes fishes and crustaceans.

**Interest to Fisheries :** No major fishery exist for either species.

**Literature :** Silas (1963, species synopsis); Collette (in press, two species of Grammatorcynus recognized).

**Remarks:** The genus has usually been considered monotypic but Collette (in press) has shown that there are two species.

## Grammatorcynus bicarinatus (Quoy & Gaimard, 1824)

SCOMBR Gram 1

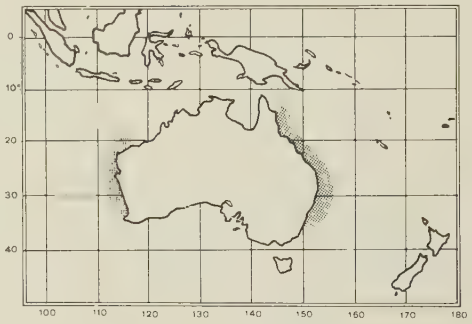
Thynnus bicarinatus Quoy & Gaimard, 1824, Voyage autour du Monde, 3, Zoologie:357, pl. 61 (fig. 1) (Baie des Chiens-Marins = Shark Bay, Western Australia).

**Synonymy :** Grammatorcynus bicarinatus - McCulloch, 1915.

**FAO Names :** En - Shark mackerel; Fr - Thazard requin; Sp - Carite cazón.

**Diagnostic Features :** Eye small (3 to 4% of fork length); few gillrakers, 14 or 15 on first gill arch. Colour: frequently has small dark spots along the ventral surface of the body.

**Geographical Distribution :** Positively known only from the northern coasts of Australia, south to Shark Bay in Western Australia, along the east coast of Queensland south to northern New South Wales. May also occur in southern Papua New Guinean waters.




**Habitat and Biology :** Shark mackerels form dense concentrations near individual bays and reefs in Barrier Reef waters. With the rising tide, they move into shallow water over the reef flats, feeding on schools of clupeoid fishes that concentrate there (Grant, 1982).

**Size :** Maximum size is 110 cm fork length and 13.5 kg weight (Lewis, 1981).

**Interest to Fisheries :** The only fishery directed at this species is based in Queensland where it is a high-ranking tablefish (Grant, 1982).

**Local Names :** AUSTRALIA: Large-scaled tunny, Salmon mackerel, Shark mackerel.

**Literature :** Grant (1982, Queensland).

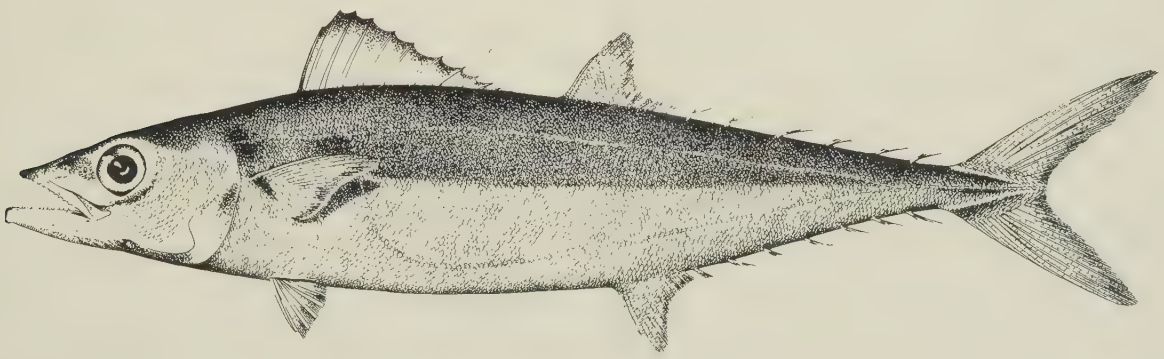
**Remarks :** The name shark mackerel comes from the ammonia-like smell noticed upon cleaning them. This odour can be masked by brushing the fillets with lemon juice prior to cooking (Grant, 1982).

**Grammatorcynus bilineatus** (Rüppell, 1836) SCOMBR Gram 2

Thynnus bilineatus Rüppell, 1836, Fische des Rothen Meeres: 39-40, pl. 12, fig. 2 (Red Sea).

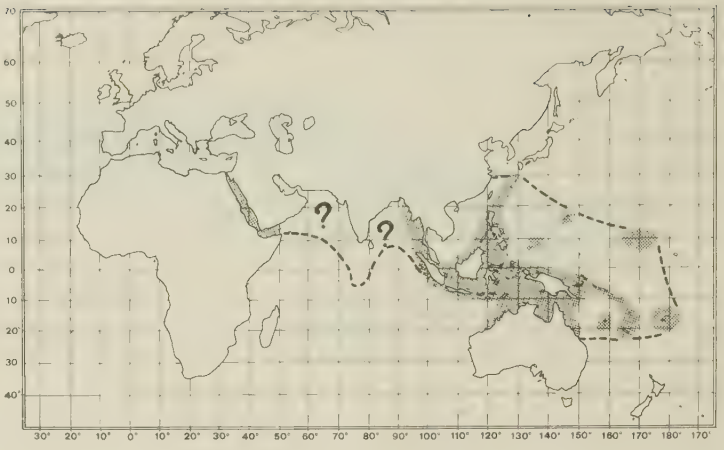
**Synonymy :** Grammatorcynus bilineatus - Gill, 1862; Nesogrammus piersoni Evermann & Seale, 1907.

**FAO Names :** En - Double-lined mackerel; Fr - Thazard-kusara; Sp - Carite cazón pintado.



**Diagnostic Features :** Eye large (7 to 9% of fork length); many gillrakers, 19 to 24 on first gill arch. Colour: usually lacks any spots along the ventral surface of the body.

**Geographical Distribution :** Tropical and subtropical waters of the Indo-West Pacific from the Red Sea east to the Andaman Sea, Java Sea, the Philippines, Ryukyu Islands, Irian Jaya, Papua New Guinea, northern coasts of Australia, Solomon Islands, New Caledonia, Caroline and Marshall Islands, and Fiji.




**Habitat and Biology :** An epipelagic species that is mostly found in shallow reef waters where it forms large schools. Reports on reproduction are available for the Andaman Sea, the Sulu Sea south of the Philippines, and Fiji. The spawning season in Fiji extends from October through March (Lewis, Chapman & Sesewa, 1983). An ovary weighing 34.4 g (length or weight of the fish not available) contained about 93 000 eggs.

Food includes adults and larvae of crustaceans and fishes, particularly clupeoids like Sardinella and Thrissocles, but also other fishes such as Sphyraena and Balistes.

**Size :** Maximum size is about 60 cm fork length and 3.5 kg weight. Maturity seems to be attained at a fork length of 40 to 43 cm (Silas, 1963; Lewis, Chapman & Sesewa, 1983).

**Interest to Fisheries :** Double-lined mackerel is taken incidentally with hand lines off Port Blair, Andaman Islands (Silas, 1963). It is common in the offshore zones of Fiji but is only occasionally seen in Fiji markets (Lewis, Chapman & Sesewa, 1983). The flesh is mild and pleasantly flavoured, but it is necessary to remove the kidney tissue before cooking to avoid the ammonia smell.

**Local Names :** AUSTRALIA: Double-lined mackerel, Scad mackerel; FIJI: Salala-ni-toga; INDIA: Double-lined mackerel; JAPAN: Nijo-saba; Ryukyu Islands: Kusarah; PACIFIC ISLANDS TRUST TERRITORIES: Palau: Biturchturch, Mokorkor; USSR: Dvukhlinejnaya makrel.

**Literature :** Silas (1963, species synopsis); Lewis, Chapman & Sesewa (1983, Fiji).

**Remarks :** This species has usually been referred to in the literature under the name G. bicarinatus until two species were distinguished (Collette, in press).

One of the Palauan names for the species, biturchturch, means urine and refers to the ammonia smell given off by these fish if they are boiled without removing the kidney tissue from along the back bone (Johannes, 1981:187).

## Gymnosarda Gill, 1862

SCOMBR Gymno

**Genus with reference :** Gymnosarda Gill, 1862:125. Type-species: Thynnus unicolor Rüppell, 1836, by original designation.

## Gymnosarda unicolor (Rüppell, 1838)

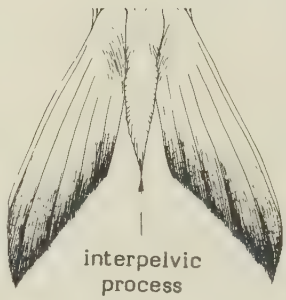
SCOMBR Gymno 1

Thynnus (Pelamis) unicolor Rüppell, 1836, Fische des Rothen Meeres:40-41, pl. 12 (fig. 1) (Jeddah, Red Sea).

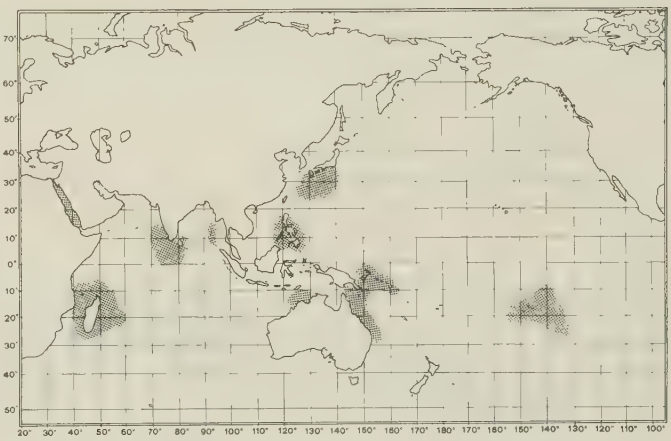
**Synonymy :** Pelamys nuda Günther, 1860; Gymnosarda unicolor - Gill, 1862; Gymnosarda nuda - Kishinouye, 1923.

**FAO Names :** En - Dogtooth tuna; Fr - Bonite à gros yeux; Sp - Casarte ojón.

**Diagnostic Features :** Body elongate and moderately compressed. Mouth fairly large, upper jaw reaching to middle of eye; 14 to 31 large, conical teeth in upper jaw, 10 to 24 in lower jaw; 2 patches of teeth on upper surface of tongue; 11 to 14 gillrakers on first gill arch; laminae of olfactory rosette 48 to 56; interorbital width 32.1 to 40% of head length. Dorsal fins close together, the first with 13 to 15 spines, its margin almost straight, the second followed by 6 or 7 finlets; anal fin with 12 or 13 rays followed by 6 finlets; pectoral fins with 25 to 28 rays; interpelvic process large and single. Lateral line strongly undulating. Body naked posterior to corselet except for the lateral line, dorsal fin base, and caudal keel; caudal peduncle slender, with a well developed lateral keel between 2 smaller keels on each side. Swimbladder large; spleen visible in ventral view on the right side of the body in the anterior half of the visceral cavity; liver with elongate left and right lobes and a short middle lobe. Vertebrae 19 precaudal plus 19 caudal. Colour: back and upper sides brilliant blue-black, lower sides and belly silvery; no lines, spots or other markings on body; anterior edge of first dorsal fin dark; other fins greyish.




**Geographical Distribution :** Tropical Indo-West Pacific (Collette and Chao, 1975:fig. 69) from the Red Sea and East Africa east to Japan, the Philippines, Papua New Guinea, and Australia and out into the islands of Oceania - the Marquesas, Tahiti, Tuamotus, Pitcairn, and Oeno Islands.



**Habitat and Biology :** An epipelagic species, usually encountered around coral reefs, at water temperatures ranging between 20 and 28°C. Dogtooth tuna are generally solitary, or occur in small schools of six or less individuals. They are voracious predators on small schooling fishes such as scads (Decapterus), Caesio, Naso, Cirrhilabrus, Pterocaesio (Randall, 1980) and squids. In Fiji, spawning occurs over the summer months (Lewis, Chapman & Sesewa, 1983), but little is known about their biology.

**Size :** Maximum size is about 150 cm fork length and 80 kg weight. The all-tackle angling record is a 131 kg fish with a fork length of 206 cm taken at Kwan-Tall Island, Korea, in 1982. At Ogosawara Islands, sizes of fish commonly taken vary between 100 and 150 cm in length and 20 and 30 kg weight; in Fiji between 65 and 100 cm and 5 to 15 kg. Fork length at first maturity is about 65 cm (Lewis, Chapman & Sesewa, 1983).

**Interest to Fisheries :** There are no fisheries directed specifically at dogtooth tuna. The species is regularly caught in small numbers during certain seasons at Port Blair, Andaman Islands, the Philippines, outside the reefs off Queensland, and near the Ryukyu and Ogasawara Islands, Japan (Silas, 1963a:898) near offshore reefs in Fiji (Lewis, Chapman & Sesewa, 1983), off Tahiti, Western Samoa and the Marquesas. Hand lines, pole-and-line fishing, and surface trolling are the usual methods of capture. Initial high catches are usually not maintained.

**Local Names :** AUSTRALIA: Dogtooth tuna; Queensland: Pegtooth tuna; Scaleless tuna, Whiteflesh tuna; FIJI: Yatu-ni-toga; INDIA: Dogtooth tuna; JAPAN: Isomaguro, Tokakin; MALDIVES: Dogtooth tuna, Worhimas (Divehi); PACIFIC ISLANDS TRUST TERRITORIES: Palau: Yassur (Tobi); PITCAIRN ISLAND: Jackass; SEYCHELLES: Thon blanc (juveniles), Thon gros yeux; SOUTH AFRICA: Dogtooth tuna, Hoektand-tuna; TANZANIA: Jodary (Swahili), Tunny; USSR: Gimnosarda, Odnotsvetnaya gimnosarda, Odnotsvetnaya pelamida; YEMEN DEM REP: Moakaba (Arabic).

**Literature :** Silas (1963a, species synopsis); Collette & Chao (1975); Lewis, Chapman & Sesewa (1983).

**Remarks :** A moderate ciguatoxic reaction was produced by feeding 6 of 13 large fish from Enewetok Atoll (fork length 55 to 135 cm, weight 3.2 to 35.4 kg) to mongooses (Randall, 1980).

**Katsuwonus** Kishinouye, 1923 — SCOMBR Kats

**Genus with reference :** Katsuwonus Kishinouye, 1915:21. Type-species: Thynnus pelamis Linnaeus, 1758 by monotypy.

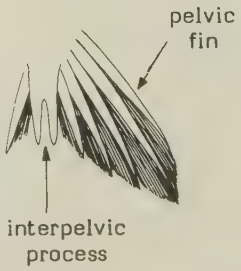
**Katsuwonus pelamis** (Linnaeus, 1758) — SCOMBR Kats 1

Scomber pelamis Linnaeus, 1758, Systema Naturae, ed. X:297.

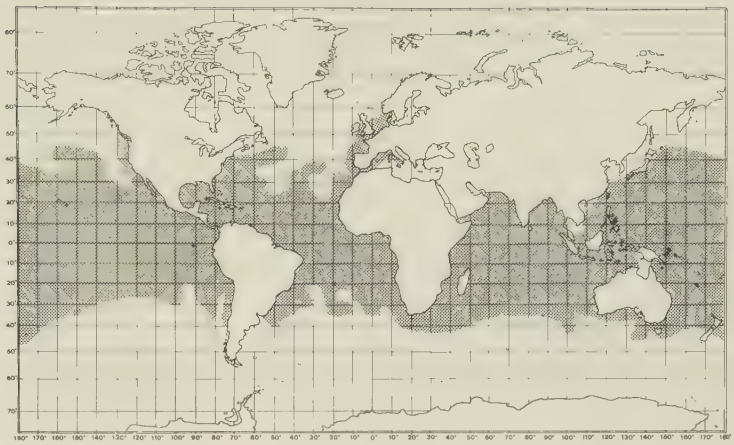
**Synonymy :** Scomber pelamides Lacepède, 1800; Scomber pelamys - Bloch & Schneider, 1801; Thynnus pelamys - Cuvier, 1817; Thynnus pelamis - Risso, 1826; Thynnus vagans Lesson, 1826; Thinnus pelamis - S.D.W., 1837; Orcynus pelamys - Poey, 1875; Euthynnus pelamys - Jordan & Gilbert, 1882; Gymnosarda pelamis - Dresslar & Fesler, 1889; Orcynus pelamis - Smitt, 1892; Katsuwonus pelamys - Kishinouye, 1915; Katsuwonus pelamis - Kishinouye, 1923; Euthynnus pelamis - Ehrenbaum, 1924; Gymnosarda pelamys - Barnard, 1927.

**FAO Names :** En - Skipjack tuna; Fr - Bonite à ventre rayé (= Listao); Sp - Listado.

**Diagnostic Features :** Body fusiform, elongate and rounded. Teeth small and conical, in a single series; gillrakers numerous, 53 to 63 on first gill arch. Two dorsal fins separated by a small interspace (not larger than eye), the first with 14 to 16 spines, the second followed by 7 to 9 finlets; pectoral fins short, with 26 or 27 rays; interpelvic process small and bifid; anal fin followed by 7 or 8 finlets. Body scaleless except for the corselet and lateral line. A strong keel on each side of caudal fin base between 2 smaller keels. Swimbladder absent. Vertebrae 41. Colour: back dark purplish blue, lower sides and belly silvery, with 4 to 6 very conspicuous longitudinal dark bands which in live specimens may appear as discontinuous lines of dark blotches.



**Geographical Distribution :** Cosmopolitan in tropical and warm-temperate waters; absent from the Black Sea.



**Habitat and Biology :** An epipelagic, oceanic species with adults distributed roughly within the 15°C isotherm (overall temperature range of occurrence is 14.7° to 30°C), while larvae are mostly restricted to waters with surface temperatures of at least 25°C. Aggregations of this species tend to be associated with convergences, boundaries between cold and warm water masses (i.e. the polar front), upwelling and other hydrographical discontinuities. Depth distribution ranges from the surface to about 260 m during the day, but is limited to near surface waters at night.

Skipjack tuna spawn in batches throughout the year in equatorial waters, and from spring to early fall in subtropical waters, with the spawning season becoming shorter as distance from the equator increases (see Matsumoto, Skillman & Dizon, in press). Fecundity increases with size but is highly variable, the number of eggs per season in females of 41 to 87 cm fork length ranging between 80 000 and 2 million.

Food items predominantly include fishes, crustaceans and molluscs. Even though Carangidae and Balistidae are part of the diet of skipjack tuna in all oceans, the wide variety of species taken suggest it to be an opportunistic feeder preying on any forage available. The feeding activity peaks in the early morning and in the late afternoon. Cannibalism is common. The principal predators of skipjack are other tunas and billfishes.

It is hypothesized that the skipjack tuna in the eastern central Pacific originate in equatorial waters, and that the pre-recruits (up to 35 cm fork length), split into a northern group migrating to the Baja California fishing grounds, and a southern group entering the central and south American fishing areas. Having remained there for several months, both groups return to the equatorial spawning areas. A similar migration pattern has been observed in the northwestern Pacific. Studies of the local movements of skipjack tuna showed that small fish (under 45 cm fork length) made nightly journeys of 25 to 106 km away from a bank but returned in the morning, while big individuals moved around more independently.

Skipjack tuna exhibit a strong tendency to school in surface waters. Schools are associated with birds, drifting objects, sharks, whales or other tuna species and may show a characteristic behaviour (jumping, feeding, foaming, etc.).

In the absence of reliable age determination methods, estimates of longevity vary at least between 8 and 12 years. A review of the present state of exploitation and potential of stocks is contained in Matsumoto, Skillman & Dizon (in press).

**Size :** Maximum fork length is about 108 cm corresponding to a weight of 32.5 to 34.5 kg; common to 80 cm fork length and a weight of 8 to 10 kg. The all-tackle angling record is a 18.93 kg fish with a fork length of 99 cm taken in Mauritius in 1982. Fork length at first maturity is about 45 cm.

**Interest to Fisheries :** Skipjack make up about 40% of the world's total tuna catch and have come to replace yellowfin as the dominant tuna species since a few years. In the period from 1978 to 1981, catches of K. pelamis were reported by 43 countries from 15 Fishing Areas. The yearly world catch in this period fluctuated between 697 760 (in 1981) and 796 034 metric tons (in 1978). Nearly half of the annual catch (47-50%) in this period was landed by Japan. Other countries landing over 10 000 metric tons per year were the USA (worldwide), Indonesia, Papua New Guinea, Solomon Islands, and the Philippines (Fishing Area 71), France, Senegal and Spain (Fishing Area 34), the Maldives and Sri Lanka (Fishing Area 51), and Ecuador (Fishing Area 77, particularly in the Gulf of Guayaquil) (FAO, 1983). In the Indian Ocean, skipjack fisheries are not yet well developed, but on the basis of the distribution of hydrographical factors, Sharp (1979) suggests areas of potential exploitation.

Skipjack tuna is taken at the surface, mostly with purse seines and pole-and-line gear but also incidentally by longlines. Other (artisanal) gear include gillnets, traps, harpoons and beach seines. The importance of flotsam or manmade aggregation devices has increased greatly in recent years. Furthermore, supporting exploration techniques such as aerial spotting find increasing application in skipjack fisheries and utilization of remote sensing is being tried experimentally. In the pole-and-line/bait boat fishery, availability of suitable bait-fish presently represents one of the major constraints and hence, efforts to culture bait-fishes are receiving more attention (Kearney & Rivkin, 1981). It appears, however, that bait rearing is hardly feasible on large enough scale to support a major fishery. Skipjack tuna are marketed fresh, frozen and canned. In Japan, they are also dried (Katsuobushi).

**Local Names :** ADEN (Gulf of): AF muss, Dabub, Hargheiba; ALBANIA: Palamida; ANGOLA: Bonito; AUSTRALIA: Skipjack, Striped tuna, Watermelon; BRAZIL: Bonito de barriga listada, Bonito rajado; BRITISH WEST INDIES: Banjo, Barriolet, Oceanic bonito, White bonito; CANADA: Oceanic bonito, Skipjack, Skipjack

tuna, Striped bonito, Thonine à ventre rayé; CHILE: Atún, Barrilete, Cachorreta, Cachureta, Cachurreta; CUBA: Atún, Merma; DENMARK: Bugstribet bonit; EGYPT: Tunna; FRANCE: Bonite, Bonite à ventre rayé, Bonitou, Bounicou, Listao; Tahiti: Auhopu; GERMANY FR: Bauchstreifiger, Echter Bonito; GREECE: Pelamis, Pelamys, Tonina; INDIA: Bonito, Choora, Kali-phila-mas, Metti, Oceanic skipjack, Varichoora; INDONESIA: Cakalang, Skipjack, Tjakalong, Tjakalong-lelaki, Tjakalong-merah, Tjakalong-perempuan; ISRAEL: Balamida; ITALY: Impiriali, Nzirru, Paamia, Paamitun, Palamatu, Palametto, Palamia, Palamida, Palamitu, Palometta, Tonina de Dalmazia, Tonnetto; JAPAN: Hongatsuo, Katsuo, Katsuwo, Katuwo, Magatsuwo, Mandagatsuwo, Mandara; KENYA: Sehewa (Swahili), Skipjack; KOREA REP: Da-raeng-i, Ga-da-raeng-i, Ga-da-ri, Gang-go-deung-so, Mog-maen-dung-i, So-young-chi, Yeo-da-raeng-i; MADAGASCAR: Bonite, Bonite à ventre rayé, Diodary, M'bassi; MALDIVES: Godhaa (large), Kadumas (small), Skipjack tuna; MEXICO: Barrilete; MONACO: Bonita, Bunita; MOROCCO: L'bakoura, Listao, Listaoune; NETHERLANDS: Gestreepte tonijn; NEW ZEALAND: Bonito, Skipjack, Skipper, Striped bonito, Striped tunny; NORWAY: Bonit; PACIFIC ISLANDS TRUST TERRITORIES: Polynesia: Atu, Bonito; PAPUA NEW GUINEA: Tjakalang; PERU: Barrilete; PHILIPPINES: Bankulis, Bonito, Gulyasan, Oceanic bonito, Palawayan, Pundahan, Puyan, Skipjack, Sobad, Striped tuna, Tulingan; POLAND: Bonite; PORTUGAL: Bonito, Bonito de ventre rayado, Gayado, Listado, Sarrajao, Serra; Madeira: Gaiado; ROMANIA: Palamida, Palamida lacherda; SENEGAL: Bonite à ventre rayé (French); Kiri-kiri (Lebou); Listao (French); SOMALIA: Sehewa; SOUTH AFRICA: Bonito, Katunkel, Lesser tunny, Oceanic bonito, Pensstreep-tuna, Skipjack, Skipjack tuna, Watermelon; SPAIN: Atún de altura, Bonita, Bonito de altura, Bonito de veintre rayado, Bonito del sur, Bonitol, Lampo, Listado, Llampua, Palomida, Skipjack; Canary Islands: Bonito; SRI LANKA: Balaya, Bonito, Scorai; SURINAME: Oceanic bonito, White bonito; SWEDEN: Bonit; TAIWAN, PROVINCE OF CHINA: Then chien; TANZANIA: Sehewa. TUNISIA: Bonite, Boussenna, Ghzel; UK: Bonito, Striped bellied bonito, Striped bellied tunny; USA: Arctic bonito, Bonito, Mushmouth, Ocean bonito, Oceanic bonito, Oceanic skipjack, Skipjack, Skipjack tuna, Skippy, Striped bonito, Striped tuna, Victor fish, Watermelon; Hawaii: Aku, Aku kinai; USSR: Katsuo, Malyj tunets-bonito, Okeanskij bonito, Polosatyj tunets, Skipdzhek; VENEZUELA: Bonito; YUGOSLAVIA: Tunj prugavac, Trup prugavac.

**Literature :** Jones & Silas (1963, Indian Ocean); Postel (1963, Atlantic); Waldron (1963, Pacific); Fischer, ed. (1973, Species Identification Sheets, Mediterranean and Black Sea); Fischer & Whitehead, eds (1974, Species Identification Sheets, Eastern Indian Ocean/Western Central Pacific); Sharp & Dizon (1978); Forsbergh (1980, Pacific); Collette (1978, Species Identification Sheets, Western Central Atlantic; 1981, Species Identification Sheets, Eastern Central Atlantic); Habib, Clement & Fischer (1981); Matsumoto, Skillman & Dizon (in press, species synopsis).

**Remarks :** The East African Swahili name "Sehewa" is also in use for Auxis and small Euthynnus species.

**Orcynopsis** Gill, 1862

SCOMBR Orcy

**Genus with reference :** Orcynopsis Gill, 1862:125. Type-species: Scomber unicolor Geoffrey St. Hilaire, 1817, by original designation.

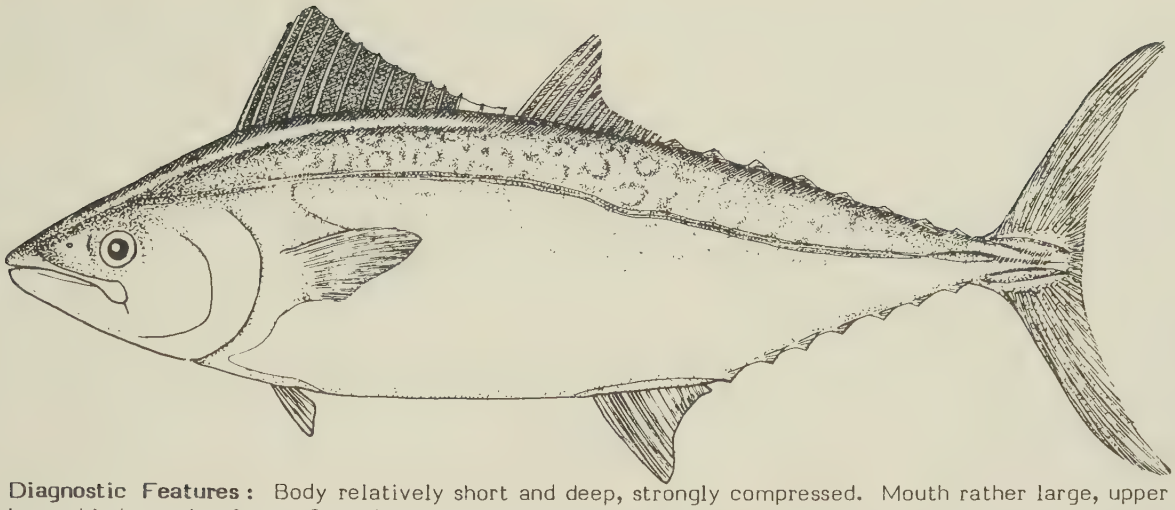
**Orcynopsis unicolor** (Geoffroy St. Hilaire, 1817)

SCOMBR Orcy 1

Scomber unicolor E. Geoffroy St. Hilaire, 1817, Description Egypte, Hist.Nat., pl. 24 (fig. 6) (Alexandria, Egypt).

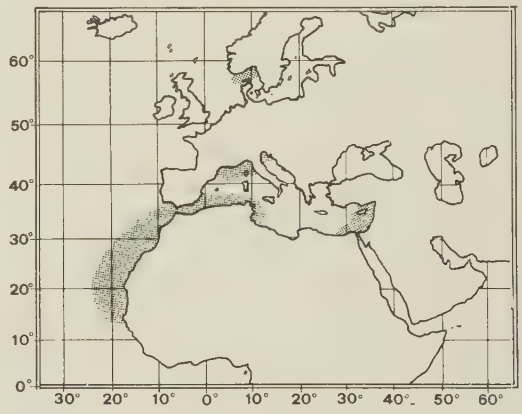
**Synonymy :** Cybium bonapartii Verany, 1847; Pelamys unicolor - Günther, 1860; Orcynopsis unicolor - Gill, 1862; Thynnus peregrinus - Collett, 1879a; Orcynopsis unicolor - Collett, 1879; Pelamichthys unicolor - Giglioli, 1880; Cybium veranyi - Giglioli, 1880; Sarda unicolor - Smitt, 1892.

**FAO Names :** En - Plain bonito; Fr - Palomette; Sp - Tasarte.



**Diagnostic Features :** Body relatively short and deep, strongly compressed. Mouth rather large, upper jaw reaching to hind margin of eye; 2 tooth patches on upper surface of tongue; 18 to 27 large conical teeth on upper jaw; 12 to 21 on lower jaw; 12 to 17, usually 14 to 16, gillrakers on first arch; laminae of olfactory rosette 25 to 28; interorbital width 23.9 to 31% of head length. Dorsal fins close together, the first short and high with 12 to 14 spines and almost straight in outline; the second with 12 to 15 rays followed by 7 to 9 finlets; anal fin with 14 to 16 rays followed by 6 to 8 finlets; pectoral fins short with 21 to 23 rays; interpelvic process small and bifid. Body naked behind the well developed corselet except for a band of scales along the bases of the dorsal fins and patches of scales around the bases of the pectoral, pelvic, and anal fins; caudal peduncle slender, with a well developed lateral keel between two smaller keels on each side. Swimbladder absent;spleen not visible in ventral view, concealed under liver; liver with an elongate right lobe and a short left lobe which tends to fuse with the middle lobe. Vertebrae 17 or 18 precaudal plus 19 to 21 caudal, total 37 to 39. Colour: back blue-black with a faint mottled pattern laterally but no prominent stripes or spots; lower sides silvery; anterior three quarters of first dorsal fin black, second dorsal fin and dorsal finlets dark, some yellow on anal fin.

**Geographical Distribution :** Eastern Atlantic from Oslo, Norway south to Dakar, Senegal (Collette & Chao, 1975:fig.69), but the range is centered in the southern Mediterranean Sea. Not known from Madeira, the Canaries or the Cape Verde Islands.




**Habitat and Biology :** An epipelagic, neritic species confined primarily to temperate waters, but juveniles may be encountered in waters of up to 30°C. Small schools of plain bonito cruise at the surface (so that the first dorsal fin stands out of the water like that of sharks), frequently associated with birds.

Plain bonito prey on a variety of mostly small schooling fishes including anchovies (Engraulis spp.), sardinellas (Sardinella spp.), jacks (Caranx spp.), mackerel (Scomber spp.), bogue (Boops sp.) and others. Its food spectrum is more restricted than that of Euthynnus alletteratus and Sarda sarda.

In the Mediterranean, the spawning season extends from July to September while off Senegal it initiates already in May. A female weighing 5 or 6 kg may carry some 500 to 600 000 eggs which are spawned in portions.

**Size :** Maximum size is 130 cm fork length and 13.1 kg weight; common to 90 cm and 4 to 5 kg. Females grow larger than males. Maturity is reached at about 70 to 80 cm fork length.

**Interest to Fisheries :** There seems to be no fishery directed at this species. It is taken incidentally in Tunisia, Morocco, Mauritania, and Senegal; the estimated world catch from 1978 to 1981 fluctuated between 501 (in 1979) and 1 068 metric tons (in 1981) (FAO, 1983). The major fishing gear is pole-and-line, but it is also caught with purse seines. Plain bonito is marketed canned or frozen.

**Local Names :** ALGERIA: Bonite plate, Palomète; DENMARK: Ustribet Pelamide; FRANCE: Palomète; GERMANY FR: Ungestreifter Pelamide; ITALY: Palamita bianca; Sicily: Palamitu; MALTA: Blamto; MAURITANIA: Tasarte; MOROCCO: Palomette; NETHERLANDS: Boniter; PORTUGAL: Palometa; SENEGAL: Palomette (French); Sipon (Lebou and Ouoloff); SPAIN: Tasarte; SWEDEN: Ostrimmad pelamid; TUNISIA: Qalaqt; USSR: Odnotsvetnyj bonito, Odnotsvetnyj tunets, Palometa.

**Literature :** Postel (1956); Fischer, ed. (1973, Species Identification Sheets, Mediterranean and Black Sea); Collette & Chao (1975); Trade & Postel (1955); Collette (1981, Species Identification Sheets, Eastern Central Atlantic).

**Rastrelliger** Jordan & Starks, 1908 | SCOMBR Rast

**Genus with reference :** Rastrelliger Jordan & Starks in Jordan & Dickerson, 1908:607. Type-species: Scomber brachysoma Bleeker, 1850, by original designation.

**Diagnostic Features :** Body elongate, slightly compressed. Snout pointed; front and hind margins of eye covered by an adipose eyelid; teeth in upper and lower jaws small and conical; teeth absent from vomer and palatine bones (on roof of mouth); gillrakers 21 to 48 on lower limb of first arch. Two widely separated dorsal fins (interspace at least equal to length of first dorsal fin base), the first with 8 to 11 spines, second dorsal and anal fins with 12 rays; anal spine rudimentary; 5 dorsal and 5 anal finlets; interpelvic process small and single; pectoral fin short, with 19 or 20 rays. Scales behind head and around pectoral fins larger and more conspicuous than those covering rest of body but no well developed corselet. Two small keels on each side of caudal peduncle (at base of caudal fin lobes), but no central keel between them. Swimbladder present. Vertebrae 13 precaudal plus 18 caudal, total 31; first interhaemal bone anterior to haemal spine of 14th vertebra. Last branchiostegal ray forming wide plate. Colour: back blue-green with 2 rows of small, dark spots on sides of dorsal fin bases, no vertically zig-zag or wavy lines as are present in Scomber; sides and belly silvery, sometimes with several narrow horizontal stripes.

**Habitat and Biology :** The genus comprises three epipelagic, neritic species occurring in areas where surface temperatures do not fall below 17°C, forming schools of equally sized individuals. Even though there is much overlap in the geographical distribution of the species, food competition is reduced by the selection of different, complementary plankton fractions. Predators include sharks, seerfishes, ribbonfishes, tunas and dolphins.

**Interest to Fisheries :** The world catch of Rastrelliger increased from 286 000 metric tons in 1975 to about 367 000 in 1981 (FAO, 1983). Countries scoring highest landings were Indonesia, Thailand, India, Malaysia and the Philippines taking mackerels with purse seines, encircling gillnets, lift nets, fish corrals and bamboo stake traps. The fish are marketed fresh, frozen, canned, dried salted and smoked.

**Literature :** Matsui (1967).

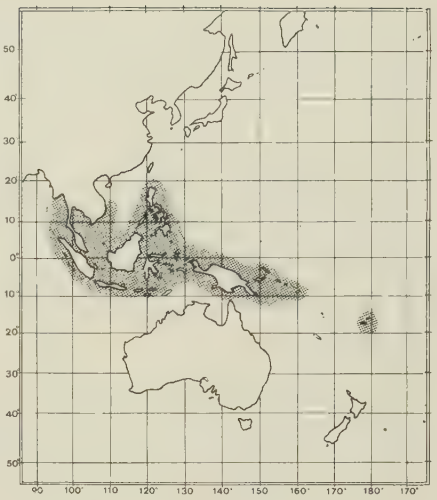
**Rastrelliger brachysoma** (Bleeker, 1851) | SCOMBR Rast 1

Scomber brachysoma Bleeker, 1851a, Nat.Tijdschr.Ned.-Ind., 1:356 (Batavia).

**Synonymy :** Scomber neglectus Kampen, 1907; Rastrelliger brachysoma - Jordan & Dickerson, 1908; Rastrelliger neglectus - Beaufort, 1951.

**FAO Names :** En - Short mackerel; Fr - Maquereau trapu; Sp - Caballa rechoncha.

**Diagnostic Features :** Body very deep, its depth at margin of gill cover 3.7 to 4.3 times in fork length; head equal to or less than body depth. Maxilla covered by lacrimal bone but extending nearly to end of lacrimal; gillrakers very long, visible when mouth is opened, 30 to 48 on lower limb of first gill arch; numerous bristles on longest gillraker, about 150 on one side in specimens of 12.7 cm, 210 in specimens of 16 cm, and 240 at 19 cm fork length. Intestine very long, 3.2 to 3.6 times fork length. Colour: spinous dorsal fin yellowish with a black edge, pectoral and pelvic fins dusky, other fins yellowish.



**Geographical Distribution :** Central Indo-West Pacific from the Andaman Sea east to Thailand, Indonesia, Papua New Guinea, Philippines, Solomon Islands, and Fiji.

**Habitat and Biology :** An epipelagic, neritic species that tolerates slightly reduced salinities in estuarine habitats and occurs in areas where surface temperatures range between 20° and 30°C. It schools by size. Batch-spawning is believed to extend from March through September. The short mackerel feeds chiefly on microzooplankton with a high phytoplankton component.

**Size :** Maximum fork length is 34.5 cm, common from 15 to 20 cm; length at first maturity is about 16 cm.

**Interest to Fisheries :** Catches of this species are usually either recorded as Rastrelliger spp. or are combined with R. kanagurta. It is the most important commercial species of mackerel in the Philippines, caught the year round with native purse seines (italakop) and fish corrals (ibaklad) in Manila Bay (Manacop, 1958) and by dynamiting. In India, it is fished with a variety of gear such as gillnets, seines, and cast and drift nets operated from boats with out-riggers and from dugout canoes. The catch in the Philippines fluctuated between 25 183 metric tons in 1978 and 18 962 metric tons in 1981 (FAO, 1983).

**Local Names :** INDIA: Andaman Islands: Bangadi (Hindi), Chappata; INDONESIA: Kembung perempuan; KAMPUCHEA: Cá bao ma, Plathu; MALAYSIA: Kembong; PHILIPPINES: Aguma-a (Bikol, Visayan), Asa-asa (Pampango), Hasa-hasa (Tagalog, Visayan Banton) Chub mackerel, Kabalyas (Bikol, Tagalog), Linchay (Tagalog), Luman (Kuyano, Tagbanwa), Masangi (Tagalog), Short-bodied mackerel, Tulay (Tagalog); SINGAPORE: Kembong; SOUTH AFRICA: Soeklig-makriel, Spotlight mackerel; USSR: Tropjcheskaya skumbriya; VIET NAM: Cá bao ma, Plathu.

**Literature :** Manacop (1958); Jones & Silas (1964); Jones & Rosa Jr. (1967); Fischer & Whitehead, eds (1974, Species Identification Sheets, Eastern Indian Ocean/Western Central Pacific).

**Remarks :** Some common names listed for this species may also or exclusively be in use for R. faughni.

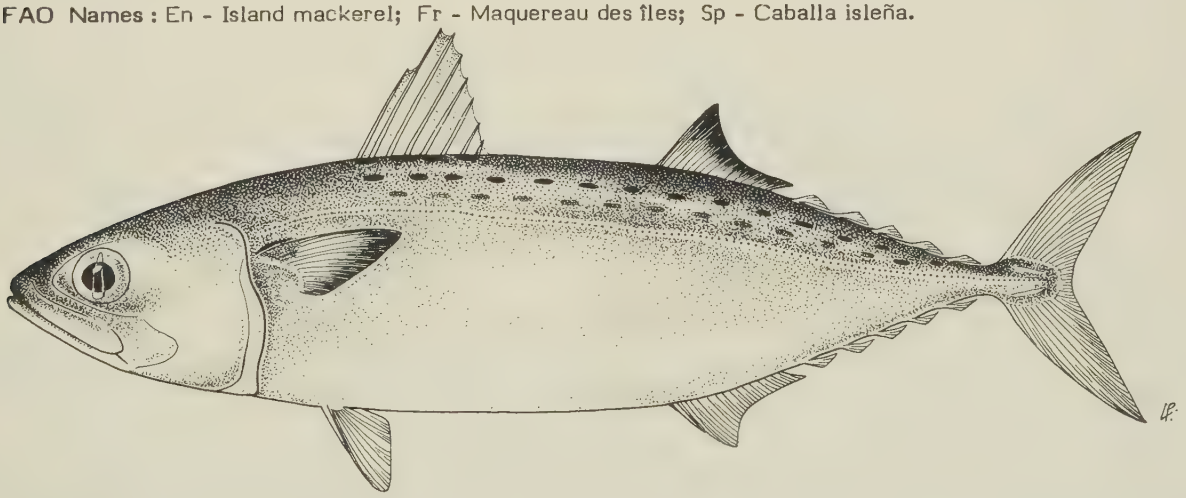
**Rastrelliger faughni** Matsui, 1967

SCOMBR Rast 2

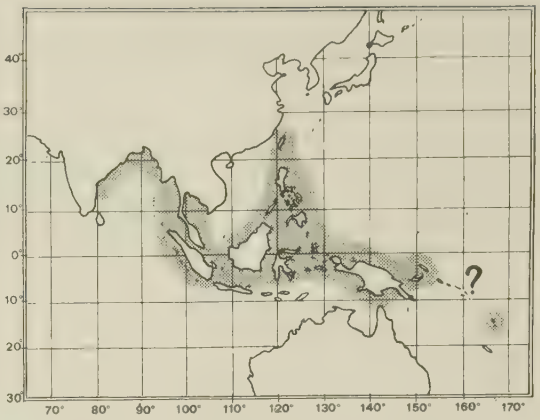
Rastrelliger faughni Matsui, 1967, Copeia, 1967(1):74-77, fig. 1 (Ulugan Bay, Philippines).

**Synonymy :** None.

**FAO Names :** En - Island mackerel; Fr - Maquereau des îles; Sp - Caballa isleña.



**Diagnostic Features :** Body slim, its depth at margin of gill cover 4.9 to 6.0 times in fork length; head longer than body depth. Maxilla covered by lacrimal bone extending only 3/4 the length of the lacrimal. Gillrakers shorter than snout; when mouth is opened wide, gillrakers do not extend far into mouth; 21 to 26 rakers on lower limb of first gill arch; few bristles on longest gillraker, 30 to 55 on one side. Intestine short, less or about equal to fork length. Colour: belly yellowish silver; 2 to 6 large spots at base of first dorsal fin, visible from above; two faint stripes at level of lateral line in some specimens; a black blotch behind pectoral fin base; outer margin of dorsal and pectoral fins dark.




**Geographical Distribution :** Central part of the Indo-West Pacific from Taiwan Island, south through the Philippines and New Britain and east to Fiji (new record), west through Indonesia, Thailand and Malaysia, to India at least as far as Madras.

**Habitat and Biology :** Island mackerel, like all species of the genus Rastrelliger, is epipelagic, neritic, occurring in waters where surface temperatures do not fall below 17°C. It feeds on the largest zooplankton organisms, thus complementing the planktonic food spectrum of the other two Rastrelliger species.

**Size :** Maximum size is at least 20 cm fork length and 0.75 kg in weight.

**Interest to Fisheries :** Separate statistics are not reported for Island mackerel, but it is taken along with other species of Rastrelliger off Taiwan Island, the Philippines, Indonesia, and Malaysia. In the Philippines it is taken in commercial quantities by fish corrals (ibaklad), bag nets and round seines (sapiao) (Manacop, 1958:84).

**Local Names :** INDONESIA: Kembung; PHILIPPINES: Chub mackerel; USSR: Avstralijskaya tropjcheskaya skumbraya.

**Literature :** Manacop (1958) as Scomber australasicus; Matsui (1967); Fischer & Whitehead, eds (1974, Species Identification Sheets, Eastern Indian Ocean/Western Central Pacific).

**Remarks :** Prior to its description in 1967, several authors (such as Beaufort, 1951, and Manacop, 1958) used the name Scomber australasicus for this species. For this reason, some of the local names here given for the other two species of Rastrelliger and for Scomber australasicus may apply to R. faughni in some localities.

**Rastrelliger kanagurta** (Cuvier, 1817)

SCOMBR Rast 3

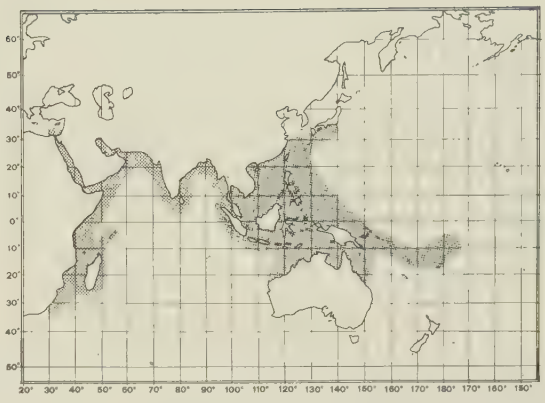
Scomber kanagurta Cuvier, 1817, Règne Animal, 2:313 (based on Russell's pl. 136, India).

**Synonymy :** Scomber loo Lesson, 1829; Scomber canagurta - Cuvier, 1829; Scomber chrysozonus Rüppell, 1836; Scomber microlepidotus Rüppell, 1836; Scomber moluccensis Bleeker, 1856; Scomber reani Day, 1870; Scomber lepturus Agassiz, 1874; Rastrelliger kanagurta - Jordan & Dickerson, 1908; Rastrelliger microlepidotus - Jordan & Dickerson, 1908; Rastrelliger loo - Jordan & Dickerson, 1908; Rastrelliger chrysozonus - Kishinouye, 1915; Rastrelliger serventyi Whitley, 1944.

**FAO Names :** En - Indian mackerel; Fr - Maquereau des Indes; Sp - Caballa de la India.

**Diagnostic Features :** Body moderately deep, its depth at margin of gill cover 4.3 to 5.2 times in fork length; head longer than body depth. Maxilla partly concealed, covered by the lacrimal bone, but extending to about hind margin of eye; gillrakers very long, visible when mouth is opened, 30 to 46 on lower limb of first arch; a moderate number of bristles on longest gillraker, 105 on one side in specimens of 12.7 cm, 140 in specimens of 16 cm, and 160 in specimens of 19 cm fork length. Intestine 1.4 to 1.8 times fork length. Colour: narrow dark longitudinal bands on upper part of body (golden in fresh specimens) and a black spot on body near lower margin of pectoral fin; dorsal fins yellowish with black tips, caudal and pectoral fins yellowish; other fins dusky.

**Geographical Distribution :** Widespread in the Indo-West Pacific from South Africa, Seychelles and Red Sea east through Indonesia and off northern Australia to Melanesia, Micronesia, Samoa, China and the Ryukyu Islands. It has entered the eastern Mediterranean Sea through the Suez Canal.



**Habitat and Biology :** An epipelagic, neritic species occurring in areas where surface water temperatures are at least 17°C. Schooling is by size. The spawning season around India seems to extend from March through September. Spawning is in several batches.

Juveniles feed on phytoplankton (i.e. diatoms) and small zooplankton such as cladocerans, ostracods, larval polychaetes, etc. With growth they gradually change their dietary habits, a process that is reflected in the relative shortening of their intestine. Hence, adult Indian mackerel prey primarily on macroplankton such as larval shrimps and fish. Longevity is believed to be at least 4 years.

**Size :** Maximum fork length is 35 cm, common to 25 cm; in Philippine waters, length at first maturity is about 23 cm.

**Interest to Fisheries :** Indian mackerel is a very important species in many parts of its range. Catches are usually recorded as Rastrelliger spp. or combined with R. brachysoma. The world catch for R. kanagurta alone fluctuated between about 96 000 metric tons in 1975 and 128 000 metric tons in 1981, peaking at about 186 000 metric tons in 1978; that of Rastrelliger spp. between about 162 000 and 220 100 metric tons respectively (FAO, 1983). Indonesia, Thailand, India, Malaysia, and the Philippines reported most of the landings. Indian mackerel is caught with purse seines, encircling gillnets, lift nets, and bamboo stake traps, and marketed fresh, frozen, canned, dried salted, and smoked.

**Local Names :** AUSTRALIA: Long-jawed mackerel; BURMA: Indian mackerel; INDIA: Ayala, Ayila (Malayalam), Ailai; Augalai (Tamil), Bangada (Canarese); Indian mackerel, Kaula gedar (Marathi), Kanagurta (Telugu) Kanangeluthi (Tamil), Kannangadatha (Telugu), Kumla (Tamil), Karan-kita (Oriya), Oibia gedar (Sindhi); Andaman Islands: Bangadi (Hindi); INDONESIA: Banjar, Kembung, Kembunglelaki; JAPAN: Agifurakiya, Gurukunmuchji, Naha; KAMPUCHEA: Cá bac ma, Cá be lau, Cá nung nuc, Trey kamong MALAYSIA: Kedah, Kembong, Kuala muda; PAKISTAN: Surmai; PHILIPPINES: Alumahan (Tagalog), Bunatan (Ilokano), Burau (Bikol), Buyaw (Visayan-Banton), Chub mackerel, Hasa-hasa, Kabalyas (Panga-Sinan), Lumahan (Tagalog), Mataan (Ilokano), Striped mackerel, Salimburaw (Kuyano and Tagbanwa); SAUDI ARABIA: Bagha; SINGAPORE: Kembong; SOMALIA: Bagha (Mij); Burei (Kism); Carmu, Numa (Baj); SOUTH AFRICA: Langkaak-makriel, Longjaw mackerel; SRI LANKA: Ailai (Tamil), Indian mackerel, Karung kuluttan, Kumbala (Tamil), Kumbalava, Maha kara bolla (Sinhalese); THAILAND: Pla-long, Pla-thu, Tu; USSR: Kanagurta, Indijskaya okeanicheskaya skumbriya, Makrelchab, Odnoglachaya makrel, Polosataya makrel; VIET NAM: Cá bac ma, Cá be lau, Cá nung nuc, Trey kamong.

**Literature :** Jones & Silas (1964a); Jones & Rosa, Jr (1967); Fischer & Whitehead, eds (1974, Species Identification Sheets, Eastern Indian Ocean/Western Central Pacific).

**Remarks :** Some local names listed here may in fact be associated with R. faughni, a species recognized only in 1967, or be in use for both.

**Sarda** Cuvier, 1829

SCOMBR Sarda

**Genus with reference :** Sarda Cuvier, 1829:199. Type-species: Scomber sarda Bloch, 1793, by monotypy.

**Diagnostic Features :** Body elongate and slightly compressed. Mouth moderately large; 12 to 30 large, conical teeth in upper jaw, 10 to 25 in lower jaw; no teeth on tongue; 8 to 21 small conical teeth in a row on the palatine; vomerine teeth present or absent; 8 to 27 gillrakers on first arch; laminae of olfactory rosette 21 to 39. Interorbital width 21.3 to 30.2% of head length. Dorsal fins close together, the first with 17 to 23 spines, its margin straight; the second with 13 to 18 rays followed by 7 to 9 finlets; anal fin with 12 to 17 rays followed by 6 to 8 finlets; pectoral fins short, with 22 to 27 rays; interpelvic process small and bifid. Lateral line single, gradually curving down toward caudal peduncle. Body completely covered with very small scales posterior to the corselet; caudal peduncle slender, with a well developed lateral keel between 2 smaller keels on each side. Swimbladder absent; spleen large and prominent in ventral view, located in the posterior half of the visceral cavity; liver with elongate left and right lobes and a short middle lobe.

**Habitat and Biology :** All four species of this genus are epipelagic in neritic waters and school by size. Bonitos feed opportunistically on a variety of small schooling fishes, squids and shrimps. Both, the juveniles and the adults may be cannibalistic.

**Interest to Fisheries :** The world catch of 2 of the 4 bonito species recently reached about 1% of the total for all scombrids while the other 2 lack importance. About 36 000 metric tons were taken in 1975, steadily increasing to 57 000 metric tons in 1981 (FAO, 1983). The Mediterranean countries and Peru have reported the highest catches. Bonitos are taken with purse seines, hook-and-line, trolling lines, set nets, trap nets, trammel nets, beach seines as well as on hook-and-line in the recreational fisheries, and are marketed fresh, frozen or processed.

**Literature :** Collette & Chao (1975); Yoshida (1980, species synopsis).

**Sarda australis** (Macleay, 1880)

SCOMBR Sarda 4

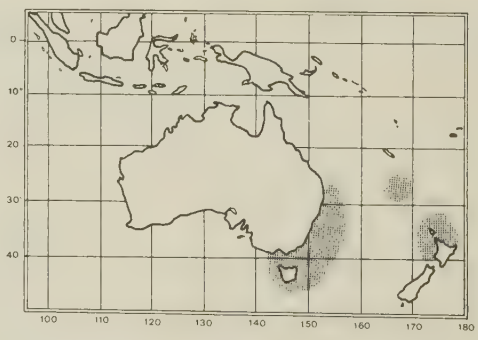
Pelamys australis Macleay, 1880, Proc.Linn.Soc.New South Wales, 5(4):557 (Sydney, Australia).

**Synonymy :** Pelamys schlegeli McCoy, 1888; Sarda australis - Walford, 1936; Sarda chiliensis australis - Roughly, 1951; Sarda chilensis australis - Silas, 1964.

**FAO Names :** En - Australian bonito; Fr - Bonite bagnard; Sp - Bonito austral.

**Diagnostic Features :** Upper jaw teeth 16 to 26; lower jaw teeth 11 to 20; vomerine teeth sometimes present; supramaxilla intermediate (Collette & Chao, 1975:fig. 32c); 19 to 21 gillrakers on first arch. First dorsal fin with 17 to 19 spines, length of fin base 31.5 to 34.3% of fork length; dorsal finlets usually 7; 14 to 17 rays in anal fin; anal finlets usually 6; pectoral fin rays 25 to 27, modally 26. Vertebrae 23 or 24 precaudal plus 21 or 22 caudal, total 45 or 46. Colour: dorsal stripes closer to being horizontal than in other species of Sarda and extending onto belly in some specimens.

**Geographical Distribution :** Restricted to southeastern Australia (Southern Queensland, New South Wales, Victoria, Tasmania) and Norfolk Island (Collette & Chao, 1975:fig. 70) and recently reported from New Zealand (James & Habib, 1979).




**Habitat and Biology :** An epipelagic, neritic species schooling by size and maturing from January through April. Because of its limited commercial interest, the biology of this species is almost completely unknown.

**Size :** Maximum fork length about 100 cm, commonly caught at 40 to 45 cm fork length and 1.8 to 2.3 kg weight. The all-tackle angling record is a 9.4 kg fish with a fork length of 101 m taken in Montague Island, New South Wales in 1978.

**Interest to Fisheries :** There is no well-developed fishery for S. australis and landings have fluctuated from nil to 9 metric tons per year over the period between 1955 and 1973 (Yoshida, 1980). It is sold in the Sydney fish market. Australian bonito incidentally caught by trolling or sportfishing is used as bait for snappers, billfishes and sharks. The flesh is light-coloured, of delicate flavour and good canning quality (Marshall, 1966).

**Local Names :** AUSTRALIA: Australian bonito, Horse mackerel, Little bonito; USSR: Avstralijskaya pelamida.

**Literature :** Collette & Chao (1975); Yoshida (1980).

**Remarks :** A number of workers have considered S. australis as a synonym or subspecies of S. chiliensis but Collette & Chao (1975) clearly showed the validity of S. australis.

**Sarda chiliensis** (Cuvier, 1831)

SCOMBR Sarda 3

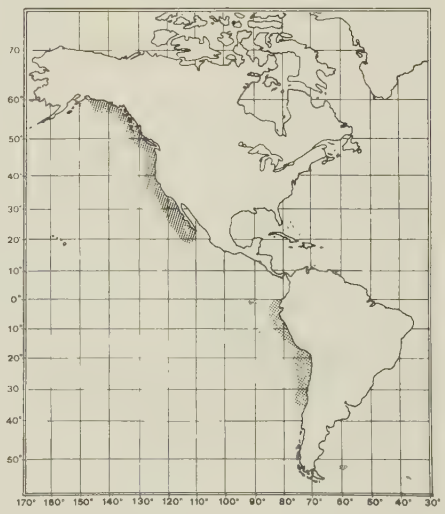
Pelamys chiliensis Cuvier in Cuvier & Valenciennes, 1831, Histoire Naturelle des Poissons, 8:163 (Valparaiso, Chile).

**Synonymy :** Pelamys lineolata Girard, 1859; Pelamys chilensis - Günther, 1860; Sarda chilensis - Jordan & Gilbert, 1882; Sarda chiliensis - Walford, 1936; Sarda lineolata - Walford, 1936; Sarda stockii David, 1943; Sarda sarda chiliensis - De Buen, 1958; Sarda chilensis chilensis - Vildosa, 1963; Sarda chilensis lineolata - Vildosa, 1963; Sarda sarda chilensis - Sanchez & Lam, 1970; Sarda chiliensis chiliensis - Kuo, 1970; Sarda chiliensis lineolata - Kuo, 1970.

**FAO Names :** En - Eastern Pacific bonito; Fr - Bonite du Pacifique oriental; Sp - Bonito del Pacífico oriental.

**Diagnostic Features :** Upper jaw teeth 18 to 30; lower jaw teeth 14 to 25; vomerine teeth absent; supramaxilla wide (Collette & Chao, 1975:fig. 32d); 23 to 27 gillrakers on first arch. First dorsal fin with 17 to 19 spines, length of fin base 26.7 to 31.4% of fork length ; dorsal finlets usually 8; 12 to 15 rays in anal fin; anal finlets usually 6 or 7; pectoral fin rays 22 to 26, usually 24 or 25. Vertebrae 22 to 24 precaudal plus 20 to 23 caudal, total 42 to 46, usually 44 or 45. Colour: dorsal stripes slightly oblique.

**Geographical Distribution :** Restricted to the eastern Pacific Ocean (Collette & Chao, 1975:fig. 70). Its geographical range includes a northern and a southern subspecies separated by a tropical population of S. orientalis. The southern subspecies, S. chiliensis chiliensis, occurs from Mancora, Peru, just south of the Gulf of Guayaquil southward to Talcahuano, Chile. The northern subspecies, S. chiliensis lineolata (Girard) occurs from off the coast of Alaska ($60^{o}16'N$, $145^{o}32'W$) southward to Cabo San Lucas at the tip of Baja California ($22^{o}20'N$, $112^{o}27'W$) and in the Revillagigedo Islands).



**Habitat and Biology :** An epipelagic, neritic species attaining sexual maturity at about 2 years of age. In the southern hemisphere, spawning occurs in nearshore waters between September and December. In the northern hemisphere, spawning begins in early March (southern populations) progressing northward in the following months as a function of increasing temperature. Evidence suggests that even 1 year old S. chiliensis lineolata may spawn in cold-water areas influenced by thermal discharges. Older bonito mature earlier in the season and tend to live further offshore as compared to younger fish. Spawning is in batches, and the number of eggs shed in one season by a 3 kg specimen has been estimated at about half a million. Fecundity increases exponentially with size.

**Size :** Maximum fork length is at least 79 cm in the southern hemisphere, and 102 cm in the northern hemisphere, where the fish may reach 11.3 kg of weight. The all-tackle angling record is a 10.07 kg fish with a fork length of 91.4 cm taken off Malibu, California in 1978. The smallest mature individuals recorded range between 47 and 53 cm fork length.

**Interest to Fisheries :** In California, eastern Pacific bonito is taken commercially by purse seiners, but is more important to the recreational hook and line fishery operating from private and party boats, piers and jetties, and from the shore (Yoshida, 1980:42). In the mid-sixties, the Chilean bonito fishery between Iquique and Antofagasta expanded from an almost entirely artisanal activity with floating gillnets and small purse seines to an industrial operation with specialized bonito/tuna vessels (Yoshida, 1980:42). The landings of the northern subspecies (S. c. lineolata) in California and Mexico have fluctuated greatly over the last 50 years from less than 1 000 metric tons to nearly 14 000 tons in the early seventies, ranking in 13th place (4 003 metric tons worth $1 222 000) in total California landings of 1976. The Peruvian landings of the southern subspecies (S. c. chiliensis) increased from almost nil in 1940 to a peak of 110 000 metric tons per year in the early sixties, thereafter gradually dropping off to 40 000 tons in the mid-seventies (Yoshida, 1980:44). The world catch for the species as a whole was down to between 10 219 in 1976 and 15 936 metric tons in 1981, reaching 21 308 metric tons in 1977 (FAO, 1983).

**Local Names :** CHILE: Bonito; COLOMBIA: Bonito; MEXICO: Bonito; PERU: Aguadito, Bonito, Cerrajón, Chaucha, Chauchilla (for 1 year old), Monillo, Monito, Mono; SWEDEN: Chilensk bonit; USA: Pacific bonito; USSR: Chilijskaya pelamida, Vostochnaya pelamida.

**Literature :** Ancieta (1964); Kuo (1970); Yoshida (1980, species synopsis); Collins & Mac Call (1977).

**Remarks :** For the scope of this catalogue the species is treated as a whole, although some information pertaining to the northern and southern subspecies is given separately.

**Sarda orientalis** (Temminck & Schlegel, 1844) — SCOMBR Sarda 2

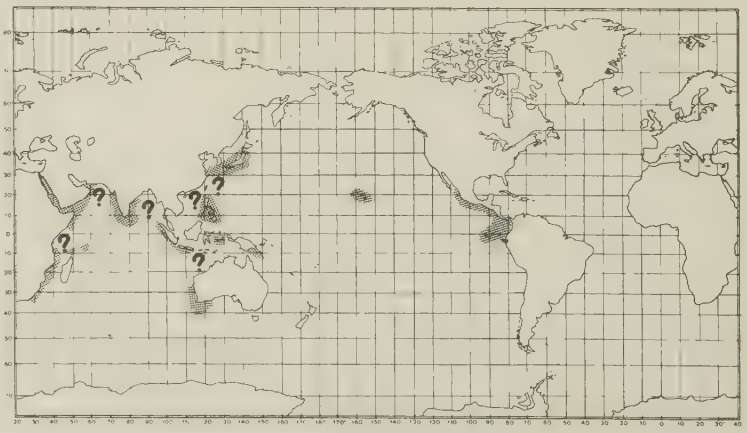
Pelamys orientalis Temminck & Schlegel, 1844, Pisces in Von Siebold, Fauna Japonica, 3:99, pl. 52 (Japan).

**Synonymy :** Sarda orientalis - Jordan & Snyder, 1900, Sarda velox Meek & Hildebrand, 1923; Sarda orientalis serventyi Whitley, 1945.

**FAO Names :** En - Striped bonito; Fr - Bonito oriental; Sp - Bonito mono.

**Diagnostic Features :** Upper jaw teeth 12 to 20; lower jaw teeth 10 to 17; vomerine teeth absent; supramaxilla narrow (Collette & Chao, 1975:fig. 32e); 8 to 13 gillrakers on first arch. First dorsal fin with 17 to 19 spines, length of first dorsal fin base 28.2 to 32.7% of fork length; dorsal finlets usually 8; 14 to 16 rays in anal fin; anal finlets usually 6; pectoral fin rays 23 to 26, usually 24 or 25. Vertebrae 23 to 25 precaudal plus 20 to 22 caudal, total 44 or 45. Colour: dorsal stripes oblique.

**Geographical Distribution :** Widespread in tropical and sub-tropical waters of the Indo-Pacific (Collette & Chao, 1975:fig. 70). In the western Pacific, it occurs northward to the northern end of Honshu, Japan (about 41°N), is rare in the Indo-Australian Archipelago, but is found in northwestern and southwestern Australia. There are recent records from off the west coast of Sumatra, south of Java, and near Bali (T. Gloerfelt-Tarp, pers. comm.) from Ambon (Indonesia) and the Gulf of Papua. Further east, it occurs around the Hawaiian Islands and along the Pacific coast of America to Cabo San Lucas at the southern tip of Baja California and the Tres Marias Islands southward to the Galapagos Islands and the Gulf of Guayaquil.



**Habitat and Biology :** An epipelagic, neritic species occurring in waters of 13.5° to 23°C, schooling with small tunas. Off the southwest coast of India fully mature striped bonito are found from May to September, followed by juveniles from October to November. Off south and southwest Sri Lanka it occurs throughout the year, with mature fish prevailing between September and February. Juveniles are encountered off the west coast of Sri Lanka from June to August. Striped bonito prey upon clupeids, other fishes, cephalopods and decapod crustaceans.

**Size :** Maximum fork length in the Indian Ocean is 101.6 cm, common 30 to 50 cm fork length; in Japanese waters to about 80 cm and 3.0 kg. The all-tackle angling record is a 10.65 kg fish with a fork length of 89.5 cm taken in Mahe, Seychelles, in 1975.

**Interest to Fisheries :** Fisheries for striped bonito are not well developed in most parts of its range (Yoshida, 1980:43). In Japan, it is taken often together with other scombrids by various types of gear including trolling lines, pole-and-line, purse seines, and set nets. There is a minor trap fishery for the species in the Philippines, and small-scale drift net operations around Sri Lanka and off southwestern India.

**Local Names :** AUSTRALIA: Oriental bonito; COLOMBIA: Bonito; COSTA RICA: Mono; ECUADOR: Bonito sierra; INDIA: Oriental bonito, Vari choora (Malayalam); JAPAN: Hagatsuo, Hosan, Kitsune, Kitsune-gatsuo, Sabagatsuo, Shimagatsuo, Sujigatsuo, Tozan; MAURITIUS: Brasse à dents; MEXICO: Bonito; PANAMA: Bonito; PERU: Bonito, Mono; SEYCHELLES: Brasse à dents; SOMALIA: Sinufa; SOUTH AFRICA: Streep-bonito, Striped bonito; SRI LANKA: Thora-baleya; USA: Bonito, Striped bonito; USSR: Vostochnaya pelamida, Prodolnopolosaya bonita; VIET NAM: Ca ngv'o phuo'ng dong.

**Literature :** Kikawa et al. (1963a); Silas (1963b, species synopsis); Fischer & Whitehead, eds (1974, Species Identification Sheets, Eastern Indian Ocean/Western Central Pacific); Yoshida (1980, species synopsis).

**Remarks :** Several authors have erroneously considered S. orientalis as a synonym of S. chiliensis.

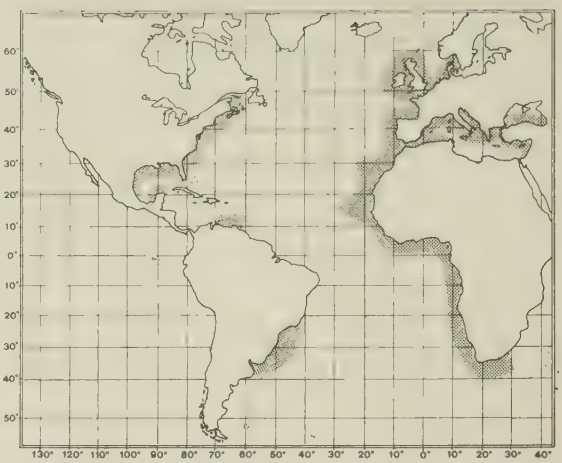
**Sarda sarda** (Bloch, 1793) | SCOMBR Sarda 1

Scomber sarda Bloch, 1793, Naturgeschichte der ausländischen Fische, 7:44-48, pl. 334 (Europe).

**Synonymy :** Scomber mediterraneus Bloch & Schneider, 1801; Scomber palamitus Rafinesque, 1810; Scomber ponticus Pallas, 1811; Thynnus sardus - Risso, 1826; Thynnus brachypterus Cuvier, 1829; Sarda sarda - Cuvier, 1829; Pelamys sarda - Cuvier in Cuvier & Valenciennes, 1831; Palamita sarda - Bonaparte, 1831; Pelamis sarda - Valenciennes, 1844; Sarda pelamys - Gill, 1862; Sarda mediterranea - Jordan & Gilbert, 1882.

**FAO Names :** En - Atlantic bonito; Fr - Bonite à dos rayé; Sp - Bonito atlántico.

**Diagnostic Features :** Upper jaw teeth 16 to 26; lower jaw teeth 12 to 24; vomerine teeth sometimes present; supramaxilla intermediate (Collette & Chao, 1975:fig. 32f); 16 to 23 gillrakers on first arch. First dorsal fin with 20 to 23 spines, length of fin base 29.1 to 33% of fork length; dorsal finlets usually 8; 14 to 17 rays in anal fin; anal finlets usually 7; pectoral fin rays 23 to 26, usually 24 or 25. Vertebrae 26 to 28 precaudal plus 23 to 27 caudal, total 50 to 55, more than in any other species of Sarda. Colour: dorsal stripes oblique, with a greater angle than in other species of Sarda.



**Geographical Distribution :** Tropical and temperate coasts of the Atlantic Ocean, including the Gulf of Mexico and the Mediterranean and Black seas (Collette & Chao, 1975:fig. 70). In the western Atlantic, it has been taken at several localities along the outer coast of Nova Scotia but its usual northern limit is Cape Ann, Massachusetts. It is uncommon around southern Florida, present in the northern Gulf of Mexico, but apparently absent from most of the Caribbean Sea. It is known from Colombia and Venezuela and is much more common south of the Amazon River to northern Argentina. In the eastern Atlantic, it has been taken from near Oslo, Norway south to Port Elizabeth, South Africa.

**Habitat and Biology :** An epipelagic, neritic, schooling species that can adapt to gradual but not sudden changes in the environment and may occur in water temperatures between 12° and 27°C and salinities between 14 and 39°/ooS, entering estuaries such as Miramichi and the Gulf of St. Lawrence. In most parts of the Mediterranean, spawning occurs between May and July, but off Algeria it extends from March to May. In the eastern Atlantic, it occurs from December to June, including peaks in January and April, off Dakar, and from June to July in Moroccan waters. In the northwestern Atlantic, bonitos spawn in June and July. Adults prey primarily on small schooling fishes, the choice of species depending on the locality. In the Gulf of Mexico, it was also found to feed on a number of invertebrates like squid and shrimps. It can swallow relatively large prey, and both the juveniles and the adults are known to be cannibalistic.

**Size :** Maximum fork length in the Black Sea is 85 cm and 5 kg weight; in the western Atlantic, the largest fish caught is reported as measuring 91.4 cm fork length and weighing 5.4 kg; common to 50 cm fork length and about 2 kg weight. The all-tackle angling record is a 7.6 kg fish with a fork length of 78 cm taken in the Canary Islands in 1980. Minimum length at first maturity is about 39.5 cm in males and 40.5 cm in females.

**Interest to Fisheries :** There are fisheries of various sizes throughout most of the range of S. sarda. The species is particularly important in the Mediterranean and Black seas where it is taken by trap net, ring net, gillnet, trammel net, purse seine, beach seine, and hook and line (Demir, 1963). In the period from 1978 to 1981, 11 countries reported catches of S. sarda from Fishing Area 37, steadily increasing from 9 400 to about 29 400 metric tons per year (FAO, 1983). Fishing in the Black Sea peaks between May and October, while in the Mediterranean it may vary from area to area or even extend throughout the year. The yearly world catch reported for the species in the above period tended upwards from 14 892 to 41 385 metric tons (FAO, 1983). Fishing in the eastern tropical Atlantic takes place between October and May, while it extends throughout the year off Morocco. In the Bay of Biscay, the season is much shorter, from mid-April to mid-May, however, Spanish vessels may extend their operation through November. Peak fishing of the Spanish fleet all around the peninsula is in late spring and in fall. In the western Atlantic (Gulf of Maine), Atlantic bonito is taken between June and October.

**Local Names :** ALBANIA: Palamiti; ALGERIA: Bonite, Bonite à dos rayé, Palamita, Rsela; ARGENTINA: Bonito; BRAZIL: Sarda; BULGARIA: Lakerda, Palamud, Turuk; COLOMBIA: Bonito; CUBA: Bonito; DENMARK: Rygstribet Pelamide; FRANCE: Bonite à dos rayé, Bonicou, Boniton, Boussicon, Boussicou, Conite, Pélamide, Pélamide commun, Pelamido; GERMANY FR: Pelamide, Unechter Bonito; GREECE: Doriki, Koini, Palamida, Ternata, Toriki, Touliki; ICELAND: Rákungur; ISRAEL: Sarda; ITALY: Bonnicou, Cavaritu imperiali, Cuvarita, Palamide, Palamitu maiaticus, Paamie, Palametto, Palamia, Palamita, Parantuni, Pelamida, Pilamitu, Pirantuni, Pisantuni, Sangulu, Scurma, Sgamiru, Sgonfietto, Strombo, Tombarello, Tunnacchiu; JAPAN: Hagatsuo, Kitsungegatsuo; LIBYA: Balamit, Blamto; MALTA: Palamia, Palamit, Palamita, Plamitu, Plamtu; MARTINIQUE: Bonite; MONACO: Palamida, Paramida, Piramida; MOROCCO: Bonito, Cerda; NETHERLANDS: Atlantische boniter; POLAND: Pelamida; PORTUGAL: Bonito, Serra; Madeira: Cerda; ROMANIA: Lacherda, Pelamida; SOUTH AFRICA: Atlantiese bonito, Atlantic bonito, Bonito, Katonkel, Sarrajao; SPAIN: Bonito, Bonitol, Bonitu, Cerda; SWEDEN: Pelamide, Rygstrimmig pelamid; SYRIA: Palamet; TUNISIA: Balamit, Palamid, Rsela, Toumbrel; TURKEY: Palamut, Torik; UK: Belted bonito, Pelamid, Stripe-backed pelamis; URUGUAY: Bonito; USA: Atlantic bonito, Bloater, Bone jack, Bonito, Boston mackerel, Common bonito, Skipjack; USSR: Atlanticheskaya pelamida, Lacherda, Pelamida; VENEZUELA: Cabaña blanca, Cabaña cariba, Cabaña de diente; YUGOSLAVIA: Palovnic, Pastrica, Polanda, Polandra, Sargasto, Sarica, Tombarel, Trup lacherda.

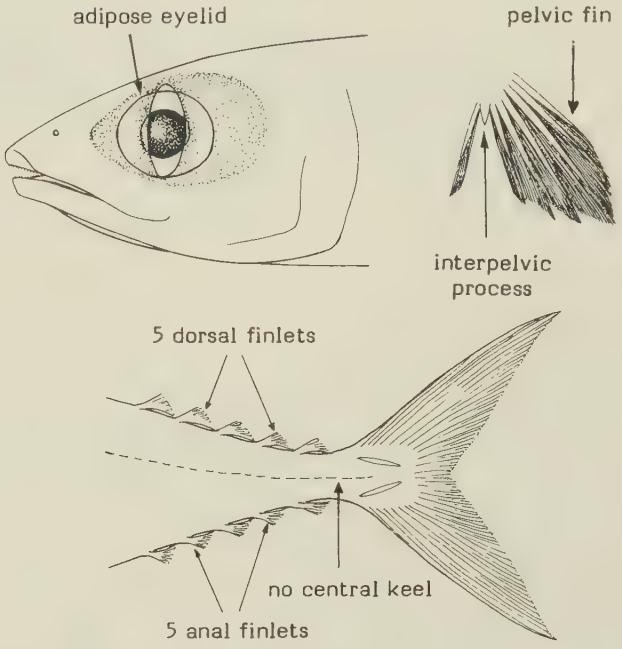
**Literature :** Demir (1963, species synopsis); Fischer, ed. (1973, Species Identification Sheets, Mediterranean and Black Sea); Yoshida (1980, species synopsis); Collette (1978, Species Identification Sheets, Western Central Atlantic; 1981, Species Identification Sheets, Eastern Central Atlantic); Rodriguez-Rodu (1981).

**Scomber** Linnaeus, 1758

SCOMBR Scom

**Genus with reference :** Scomber Linnaeus, 1758:297. Type-species: Scomber scombrus Linnaeus, 1758, by subsequent selection of Gill, 1862.

**Diagnostic Features :** Body elongate and rounded. Snout pointed; front and hind margins of eye covered by an adipose eyelid; teeth in upper and lower jaws small and conical; teeth also present on vomer and palatine bones (roof of mouth); gillrakers shorter than gill filaments, barely visible through open mouth, 25 to 35 on lower limb of first arch. Two widely separated dorsal fins, the first with 8 to 13 spines; second dorsal and anal fins with 12 rays; anal spine fairly stiff and strong; 5 dorsal and 5 anal finlets; interpelvic process small and single; pectoral fin short, with 18 to 21 rays. Entire body covered with rather small scales; scales behind head and around pectoral fins larger and more conspicuous than those covering rest of body, but no well developed corselet. Two small keels on each side of caudal peduncle (at base of caudal fin lobes), but no central keel between them. Swimbladder present or absent. Vertebrae 31. Last branchiostegal ray slightly flattened but not forming a wide plate. Colour: back steel-blue crossed by faint wavy lines; lower sides and belly silvery-yellow unmarked or with numerous dusky, rounded blotches; no rows of spots along the back next to dorsal fin bases as in Rastrelliger.




**Habitat and Biology :** The 3 species of the genus are primarily epipelagic and neritic, but the absence of a swimbladder permits S. scombrus to vary its depth rapidly. Although there is overlap in the occurrence, one species tends to dominate in a given geographical area. Except for stray individuals encountered in warmer and even tropical waters the genus Scomber seems to be basically confined to temperate water, being replaced by Rastrelliger towards the tropical regions of the Indo-West Pacific. Schooling behaviour (by size) is strongly developed and begins in the postlarval and juvenile stages. Mixed schools may include i.e. jack mackerel and Pacific sardine.

Mackerels are plankton feeders filtering copepods and other crustaceans out of the water, but adults also prey on small fish and squids. Predators include large tunas, yellowtail, billfishes, sharks, dolphins, sea lions and pelicans. The larvae are cannibalistic up to the onset of schooling behaviour (Hunter & Kimbrell, 1980).

**Interest to Fisheries :** The genus by far dominates quantitatively the scombrid catches. In 1981, the world catch of Scomber was estimated at about 2.4 million metric tons (S. japonicus alone accounted for 1.76 million metric tons) as compared to some 1.65 million metric tons for all tunas (FAO, 1983). Japan and the USSR reported highest individual catches. Mackerels are most commonly caught with purse seines. Other gear retaining some relevance include lampara nets, set nets, gillnets, trolling lines, longlines, hand lines, midwater trawls, and beach seines. They are marketed fresh, frozen, canned, smoked and salted.

**Literature :** Matsui (1967).

**Scomber australasicus** Cuvier, 1831

SCOMBR Scom 3

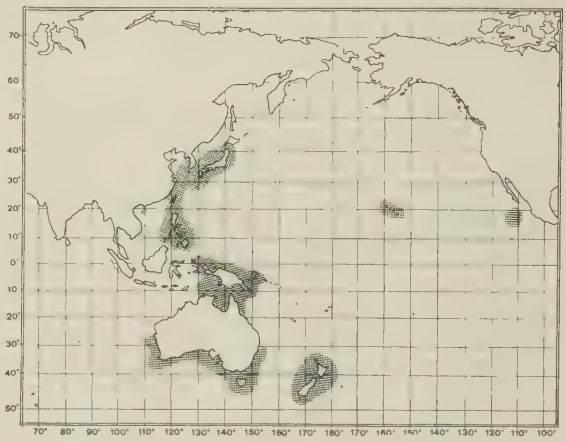
Scomber australasicus Cuvier in Cuvier & Valenciennes, 1831, Histoire Naturelle des Poissons, 8:49 (King George's Sound, Western Australia).

**Synonymy :** Scomber tapeinocephalus Bleeker, 1854; Scomber antarcticus Castelnau, 1872; Pneumatophorus tapeinocephalus - Murakami & Hayano, 1956; Pneumatophorus japonicus tapeinocephalus - Abe & Takashima, 1958.

**FAO Names :** En - Spotted chub mackerel; Fr - Maquereau tacheté; Sp - Caballa pintoja.

**Diagnostic Features :** Palatine narrow, palatine teeth in single or double rows; when double, the rows are close and running into each other. First dorsal fin with 10 to 13 spines; space between first dorsal fin groove and second dorsal fin approximately equal to length of groove; distance from 10th spine to origin of second dorsal fin clearly greater than distance between first and 10th spine; anal fin origin clearly more posterior than that of second dorsal fin, approximately opposite 4th ray of second dorsal; anal fin spine independent from anal fin. Swimbladder present. Vertebrae 14 precaudal plus 17 caudal; first haemal spine posterior to first interneural process; 15 to 20 interneural bones under first dorsal fin. Colour: markings on back oblique lines which zigzag and undulate; belly pearly-white marked with thin, wavy, broken lines which in places appear as speckling.

**Geographical Distribution :** Western Pacific Ocean from Australia and New Zealand, north to China and Japan and east to the Hawaiian Islands but relatively rare in tropical waters. Also occurs at Socorro Island, off Mexico in the eastern Pacific Ocean.



**Habitat and Biology :** An epipelagic, neritic species, schooling by size. Its biology is little known.

**Size :** Maximum fork length is 40 cm, common to 30 cm.

**Interest to Fisheries :** Although there are important fisheries for this species in Japan, Australia, and New Zealand, no catch data identified as S. australasicus are reported by these countries. Some of the catch is probably reported as S. japonicus. In Australia, it is important in the southern part of the country, from southern Queensland southward to New South Wales, Victoria, and Tasmania, and westward to South Australia and Western Australia.

**Local Names :** AUSTRALIA: Slimy mackerel; JAPAN: Gomasaba, Marusaba; NEW ZEALAND: Blue mackerel, Japanese mackerel; USSR: Avstralijskaya skumbraya.

**Literature :** Abe & Takashima (1958); Fischer & Whitehead, eds (1974, Species Identification Sheets, Eastern Indian Ocean/Western Central Pacific).

**Remarks :** The name Scomber australasicus was used by Manacop (1958) for Rastrelliger faughni.

**Scomber japonicus** Houttuyn, 1782

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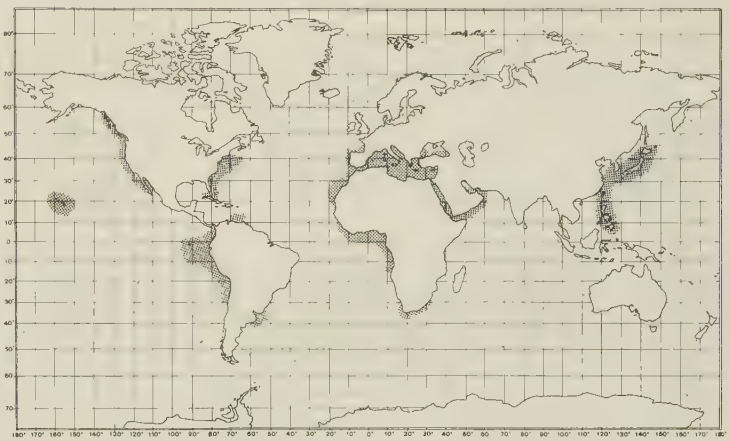
Scomber japonicus Houttuyn, 1782, Verh.Holl.Maatsch.Wet. Haarlem 20(2):331 (Japan).

**Synonymy :** Scomber colias Gmelin, 1789; Scomber pneumatophorus Delaroche, 1809; Scomber macrophthalmus Rafinesque, 1810a; Scomber grex Mitchill, 1815; Scomber capensis Cuvier in Cuvier & Valenciennes, 1831; Scomber maculatus Couch, 1832; Scomber undulatus Swainson, 1839; Scomber gracilis Swainson, 1839; Scomber saba Bleeker, 1854; Scomber janesaba Bleeker, 1854; Scomber dekayi Storer, 1855; Scomber diego Ayres, 1857; Pneumatophorus japonicus - Starks, 1922; Pneumatophorus colias - Starks, 1922; Pneumatophorus grex - Jordan & Hubbs, 1925; Pneumatophorus diego - Jordan & Hubbs, 1925; Pneumatophorus peruanus Jordan & Hubbs, 1925; Scomber gigas Fowler, 1935; Pneumatophorus japonicus marplatensis López, 1955; Scomber japonicus colias - Padoa, 1956; Scomber peruanus - Fitch & Craig, 1964.

**FAO Names :** En - Chub mackerel; Fr - Maquereau espagnol; Sp - Estornino.

**Diagnostic Features :** Palatine bone (on roof of mouth) narrow, palatine teeth in single or double rows, when double, rows close and running into each other. First dorsal fin with 9 or 10 spines; space between first and second dorsal fin less than first dorsal fin base; anal fin origin opposite that of second dorsal fin or somewhat more posterior; anal fin spine conspicuous, clearly separated from anal rays but joined to them by a membrane. Swimbladder present. Vertebrae 14 precaudal plus 17 caudal; first haemal spine posterior to first interneural process; 12 to 15 interneural bones under first dorsal fin. Colour: back with oblique lines which zigzag and undulate; belly unmarked (Pacific populations) or marked by spotting or wavy broken lines (Atlantic populations).

**Geographical Distribution :** Cosmopolitan, inhabiting the warm and temperate transition waters of the Atlantic, Indian, and Pacific oceans and adjacent seas.



**Habitat and Biology :** A primarily coastal pelagic species, to a lesser extent epipelagic or mesopelagic over the continental slope, occurring from the surface to about 250 or 300 m depth. Seasonal migrations may be very extended, the fish in the northern hemisphere moving further northward with increased summer temperatures, and southwards for overwintering and spawning. The reverse pattern generally applies to populations in the southern hemisphere. Schooling by size is well developed and initiates at approximately 3 cm. Schools of adults are the most compact and structured. Multispecies schooling in the Northeastern Pacific may occur with eastern Pacific bonito (Sarda chiliensis), jack mackerel (Trachurus symmetricus), and Pacific sardine (Sardinops sagax).

Spawning most often occurs at water temperatures of $15^{o}$ to $20^{o}$C, which results in different spawning seasons by regions, for example: off Peru, from January through May and in September; off northeastern Japan, from April to August with a peak in May, but initiating in March further south; off California and Baja California, from March through October with peaks between April and August. Spawning occurs in several batches of about 250 to 300 eggs per g of fish with the total number of eggs per female ranging from approximately 100 000 to 400 000.

The chub mackerel is believed to be in food competition with the species it schools with, such as the eastern Pacific bonito, the jack mackerel and others. Its feeding is opportunistic and non-selective, the diet of adults ranging from copepods and other crustaceans to fish and squid. Its predators include tunas, billfishes, white seabass (Cynoscion nobilis), yellowtail (Seriola lalandi) and other fishes, as well as sea lions, sharks and pelicans.

**Size :** Maximum fork length 50 cm, common to 30 cm (a fish of 47.6 cm fork length weighed 1.1 kg).

**Interest to Fisheries :** In 6 out of 11 FAO Fishing Areas (34, 41, 47, 61, 77 and 87) chub mackerel supports important commercial fisheries. Forty countries have been reporting catches of S. japonicus between 1978 and 1981. The most prominent catches are generated in Fishing Area 61, where they fluctuate between 1.3 and 2.2 million metric tons, most of which are taken by Japanese vessels. In Fishing Area 34, yearly catches often exceeded 100 000 metric tons, while in each of Areas 41, 47, 87, and 77, more than 10 000 metric tons per annum were captured in the last few years. The nominal world catch decreased steadily after the record year 1978,

when 2 861 264 metric tons were reported to FAO. While in 1980 it still amounted to over 2 million metric tons a low of 1 765 024 metric tons was registered in 1981 (FAO, 1983). Among the countries sharing this catch, the USSR ranked second behind Japan; Chile and Peru occupied the third and fourth places respectively.

At present the principal method of fishing chub mackerel is purse-seining, even though other types of gear are still being used, for example, lampara nets, set nets, trap nets, gillnets, large lift nets, spoon nets, trolling gear, balance nets, stake lines, longlines, and even trawls. Such gear is mostly used in small-scale fisheries. Between 1971 and 1974 more chub mackerel were taken in the sports fishery than in commercial operations off California (Schaefer, 1980).

Some countries have management schemes and local regulations to protect the stocks.

**Local Names :** ARGENTINA: Caballa; AUSTRALIA: Common mackerel; BRAZIL: Cavalinha; CHILE: Caballa; COLOMBIA: Caballeta, Salmonete; CUBA: Caballa; ECUADOR: Caballa, Macarela; EGYPT: Scomber; FRANCE: Maquereau espagnol; GERMAN DM RP: Japanische Makrele; GREECE: Koliós; GUATEMALA: Caballa; ISRAEL: Kolias; ITALY: Lanzardo, Scombro macchiato, Sgombro cavallo; JAPAN: Hirasaba, Masaba; MALTA: Kavall; MEXICO: Cachorreta, Macarela del Pacífico; MONACO: Cugüu; MOROCCO: Kabaila; PACIFIC ISLANDS TRUST TERRITORIES: Smaach; PERU: Caballa, Verle; PHILIPPINES: Alumahan, Lumahan (Tagalog), Japan mackerel; POLAND: Makrela kolias; PORTUGAL: Cavalinha; ROMANIA: Colios; SOUTH AFRICA: Mackerel, Makriel; SPAIN: Estornino; SWEDEN: Spank makrill; TUNISIA: Sqoumri; TURKEY: Kolyoz; UK: Chub mackerel; URUGUAY: Caballa; USA: Chub mackerel; California: Pacific mackerel; Hawaii: Opelu palahu, Saba; USSR: Afrikanskaya skumbriya, Atlanticheskaya skumbriya, Kalifornijskaya skumbriya, Vostochnaya skumbriya, Yuzhnaya skumbriya; VENEZUELA: Cachorreta, Macarela; VIET NAM: Cá thu Nhât-bán; YUGOSLAVIA: Bilica, Juja, Lancarda, Plavica.

**Literature :** Kramer (1969); Fischer, ed. (1973, Species Identification Sheets, Mediterranean and Black Sea); Sidwell et al. (1974, information on composition of edible portion); Schaefer (1980, species synopsis); Collette (1978, Species Identification Sheets, Western Central Atlantic; 1981, Species Identification Sheets, Eastern Central Atlantic).

**Scomber scombrus** Linnaeus, 1758 — SCOMBR Scom 1

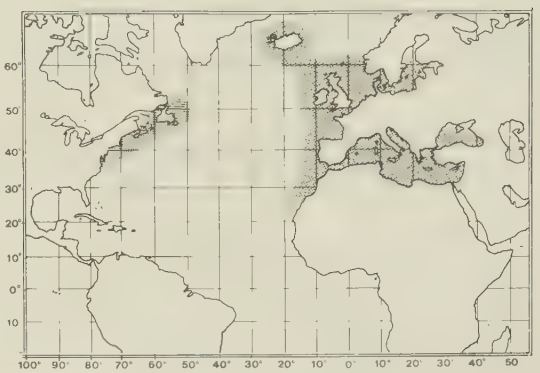
Scomber scombrus Linnaeus, 1758, Systema Naturae, ed. x:297 (Atlantic Ocean).

**Synonymy :** Scomber scomber - Brünnich, 1768; Scomber vernalis Mitchill, 1815; Scomber vulgaris S.D.W., 1849; Scomber scriptus Couch, 1867.

**FAO Names :** En - Atlantic mackerel; Fr - Maquereau commun; Sp - Caballa del Atlántico.

**Diagnostic Features :** Palatine wide, teeth in two widely spaced rows. Space between first dorsal fin groove and second dorsal fin clearly greater (approximately 1.5 times) than length of groove; anal fin origin opposite that of second dorsal fin or nearly so; anal fin spine conspicuous, joined to the fin by a membrane but clearly independent of it. Swimbladder absent. Vertebrae 13 precaudal plus 18 caudal; first haemal spine anterior to first interneural process; 21 to 28 interneural bones under first dorsal fin. Colour: markings on back oblique to near vertical, with relatively little undulating; belly unmarked.

**Geographical Distribution :** North Atlantic Ocean, including the Baltic Sea; eastern Atlantic including the Mediterranean and the Black seas; and western Atlantic from Labrador to Cape Lookout.



**Habitat and Biology :** An epipelagic and mesodemersal species, most abundant in cold and temperate shelf areas. Atlantic mackerel school by size. They overwinter in deeper waters but move closer to shore in spring when water temperatures range between 11° and 14°C. Two separate populations with little or no interchange seem to exist in the northwestern and northeastern Atlantic (including the Mediterranean).

In the western population spawning takes place from Cheasapeake Bay to Newfoundland, initiating in the south in spring and progressively extending northward during the summer. Most of the spawning takes place within 10 to 30 miles from shore, but never in low-salinity estuaries. Large fish are the first to arrive at the spawning sites.

The eastern population spawns from March to April in the Mediterranean, from May to June off southern England, northern France and in the North Sea, and from June to July in the Kattegat and Skagerrak.

Fecundity, in a medium-sized female, fluctuates between 200 000 and 450 000 eggs per season and increases with size; spawning occurs in batches. Maturity is attained at an age of 2 or 3 years.

Juvenile Atlantic mackerel feed on zooplankton (fish larvae, small crustaceans, pteropods). As they grow, they are in turn preyed upon by tunas, sharks and dolphins.

**Size :** Maximum fork length is 50 cm, common to 30 cm. In the population off the US coast, length at first maturity is approximately 34 cm in females and 32 cm in males; in the eastern part of the geographical distribution, maturity may be attained at approximately 30 cm. Females grow bigger than males.

**Interest to Fisheries :** There are important fisheries for S. scombrus in Fishing Areas 21 (Northwest Atlantic), 27 (Northeast Atlantic), and 37 (Mediterranean and Black Sea). The world catch declined from about 1.1 million metric tons in 1975 to about 610 000 metric tons in 1981 (FAO, 1983). Atlantic mackerel is mainly caught with purse seines, sometimes together with sardines. Surface catches are best when the summer thermocline is not deeper than 15 to 20 meters so as to prevent the mackerel from escaping into deeper water. Other types of gear in use include trolling lines, gillnets, traps, beach seines, and midwater trawls. This species is traded fresh, frozen, smoked and canned.

**Local Names :** CANADA: Mackerel, Maquereau; DENMARK: Almindelige, Makrel; EGYPT: Scomber; FINLAND: Makrilli; FRANCE: Maquereau commun; GERMAN DM RP: Makrele, Gemeine Makrele; GERMANY FR: Makrele, Gemeine Makrele; GREECE: Scoubri; ICELAND: Makrfll; ITALY: Lacerto, Macarello, Sgombro; MALTA: Pizzintun; MONACO: Cugüu; MOROCCO: Kabaïla; NETHERLANDS: Gewone makreel, Makreel; NORWAY: Makrell; POLAND: Makrela; PORTUGAL: Cavalla; ROMANIA: Macrou; SPAIN: Caballa; SWEDEN: Makril; TUNISIA: Sqoumri; TURKEY: Uskumru; UK: Atlantic mackerel; USA: Atlantic mackerel; USSR: Atlanticheskaya skumbriya, Skumbriya; YUGOSLAVIA: Skusa.

**Literature :** Sette (1943, 1950); Fischer, ed. (1973, Species Identification Sheets, Mediterranean and Black Sea); Collette (1981, Species Identification Sheets, Eastern Central Atlantic).

**Scomberomorus** Lacepède, 1801

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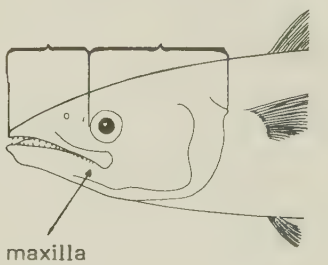
**Genus with reference :** Scomberomorus Lacepède, 1801:292. Type-species: Scomberomorus plumieri Lacepède, 1801 (= Scomber regalis Bloch, 1793), by monotypy.

**Diagnostic Features :** Body elongate, strongly compressed. Snout much shorter than rest of head; posterior part of maxilla exposed, reaching to a vertical from hind margin of eye; 5 to 38 sharp, compressed, triangular teeth in upper and lower jaws; patches of fine teeth on palatines and vomer; no teeth on tongue; gillrakers on first arch 1 to 27, 0 to 8 on upper limb, 1 to 21 on lower limb. Two scarcely separated dorsal fins, the first with 12 to 22 spines; the second with 15 to 25 rays followed by 6 to 11 finlets; anal fin with 15 to 28 rays followed by 5 to 12 finlets; interpelvic process small and bifid. Lateral line single, gradually curving down toward caudal peduncle or abruptly



bent down under the first or second dorsal fin. Body entirely covered with small scales, no anterior corselet developed. Swimbladder absent (except in S. sinensis). Vertebrae 16 to 23 precaudal plus 25 to 36 caudal, total 41 to 56. Colour: back dark blue-grey to iridescent blue green; sides silvery to white; spots, bars, lines or other markings present in most species.

**Habitat and Biology :** The genus Scomberomorus comprises 18 species occurring in coastal waters within the 20°C isotherm in both hemispheres. Their food consists largely of fishes (particularly anchovies and sardines) with smaller quantities of shrimps and squids.

**Interest to Fisheries :** The world catch of Spanish mackerels fluctuated between about 194 000 metric tons in 1975 and about 253 000 metric tons in 1981 (FAO, 1983). China, India, Indonesia, Korea, Malaysia, Mexico and the Philippines reported highest catches. Scomberomorus are caught with drift (gill) nets, trolling lines, baited hand lines, beach seines, bamboo stake traps, set nets and various other gear, including sport gear, and may be marketed fresh, salted, canned, or processed in other ways. Throughout Latin America and the Caribbean they are commonly prepared as 'cebiche', that is raw meat treated with lime juice and hot peppers. The high quality meat spoils rather quickly if it is not adequately processed.

**Literature :** Munro (1943); Collette & Russo (1979).

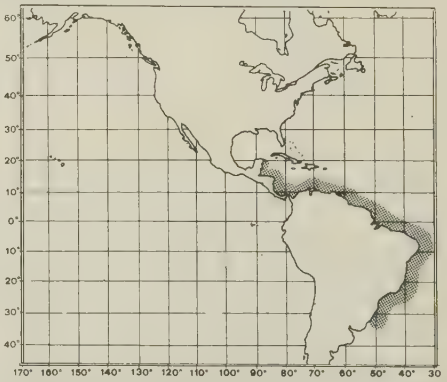
**Scomberomorus brasiliensis** Collette, Russo & Zavalla-Camin, 1978 — SCOMBR Scombm 10

Scomberomorus brasiliensis Collette, Russo & Zavalla-Camin, 1978, Fish.Bull., U.S., 76(1):274-279 (Belém, Brazil).

**Synonymy :** None.

**FAO Names :** En - Serra Spanish mackerel; Fr - Thazard tacheté du sud; Sp - Serra.

**Diagnostic Features :** Gillrakers on first arch moderate: 1 or 3 on upper limb; 9 to 13 on lower limb; 11 to 16 total (usually 13 to 15). First dorsal fin with 17 to 18 spines, rarely 19; second dorsal with 15 to 19 rays, usually 17 or 18, followed by 8 to 10 finlets; anal fin with 16 to 20 rays, usually 17 to 19, followed by 7 to 10 finlets, usually 9; pectoral fin rays 21 to 24, usually 22 or 23; pelvic fins relatively short, 3.6 to 5.9% of fork length. Lateral line gradually descending to midline on caudal peduncle. Vertebrae 19 to 21 precaudal plus 27 to 29 caudal, total 47 to 49, usually 48. Intestine with 2 folds and 3 limbs. Colour: sides silvery with several rows of round yellowish bronze (in life) spots; the number of spots increasing with size of fish from about 30 at 20 cm fork length to between 45 and 60 at fork lengths from 50 to 60 cm; first dorsal fin black anteriorly (first 7 spines) and along upper edge of posterior portion, basal portion of posterior membranes white; pectoral fin dusky; pelvic and anal fins light.



**Geographical Distribution :** Western Atlantic along the Caribbean and Atlantic coasts of Central and South America from Belize to Rio Grande do Sul, Brazil (Collette & Russo, 1979:fig. 8).

**Habitat and Biology :** An epipelagic, neritic species which seems not to migrate extensively, although off Trinidad some seasonal movement appears to occur.

In the Gulf of Paria, spawning, although occurring throughout the year, peaks from October to April (Sturm, 1978) followed by a post-spawning feeding migration away from Venezuelan waters towards Trinidad, where the species is most abundant from May to September. On the Guyana shelf, ripe fish are encountered in September (Lowe, 1962). Off northeastern Brazil, some spawning takes place offshore beyond the mayor fishing grounds throughout the year, but the main season extends from July to September (Gesteira, 1972). Sexual maturity is reached at an age of 3 or 4 years.

As in other species in the genus, food consists largely of fishes, with smaller quantities of penaeoid shrimps and loliginid cephalopods. The most important food component of 1 020 individuals (ranging between 17.5 and 87.5 cm fork length) from northeastern Brazil was the thread herring (Opisthonema oglinum) (more than 25%), followed by anchovies (Engraulidae), chub and jack mackerels (Carangidae), half-beaks (Hemiramphidae), and grunts (Pomadasyidae) (Menezes, 1970).

**Size :** Maximum fork length is 125 cm (Costa & Paiva, 1969); off Brazil; 60% of the fish in large samples taken in the period from 1962 and 1968 ranged between 40 and 65 cm; mature fish from this area had a minimum size of 46 cm (Alcantara Filho, 1977), roughly the same as off Trinidad (Sturm, 1978).

**Interest to Fisheries :** Serra Spanish mackerel is one of the most important commercial marine fishes from northeastern Brazil available throughout the year (Nomura, 1967). Most of the catch previously reported as S. maculatus from Fishing Area 31 by Colombia, Trinidad and Tobago, and Venezuela (4 120 metric tons in 1981), is in fact S. brasiliensis, as is also true for a large proportion of the Brazilian landings of Scomberomorus spp. (estimated at about 2 000 metric tons in 1981) (FAO, 1983). Catches are best in October through December (Costa & Paiva, 1969). Most of the catch is consumed fresh, but in Brazil some is salted (Paiva & Costa, 1966) and some has been canned (Bastos et al., 1973).

**Local Names :** BRAZIL: Serra; FRENCH GUYANA: Bonite, Maquereau; MARTINIQUE: Thazard franc.

**Literature :** Nomura (1967, Brazil); Costa & Paiva (1969); Sturm (1978, Trinidad).

**Remarks :** Literature records for S. maculatus from the Caribbean and Atlantic coasts of Central and South America apply to S. brasiliensis.

**Scomberomorus cavalla** (Cuvier, 1829)

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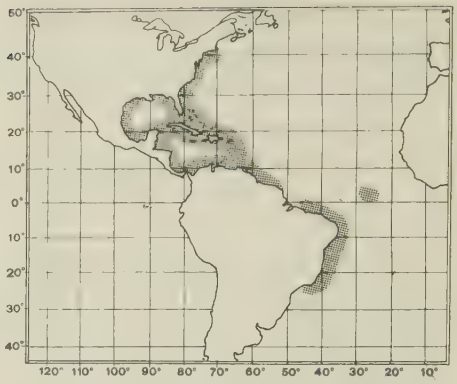
Cybium cavalla Cuvier, 1829, Règne Animal, 2nd ed., 2:200 (based on Marcgrav's Guarapucu from Brazil).

**Synonymy :** Cybium caballa - Cuvier in Cuvier & Valenciennes, 1831; Cybium immaculatum Cuvier in Cuvier & Valenciennes, 1831; Cybium acervum Cuvier in Cuvier & Valenciennes, 1831; Scomberomorus caballa - Jordan & Gilbert, 1882; Scomberomorus cavalla - Meek & Newland, 1884.

**FAO Names :** En - King mackerel; Fr - Thazard serra; Sp - Carite lucio.

**Diagnostic Features :** Gillrakers on first arch moderate: 1 to 3 on upper limb; 6 to 10 on lower limb; 7 to 13 total, usually 9 or 10. First dorsal fin with 12 to 18 spines, usually 15; second dorsal with 15 to 18 rays, followed by 7 to 10 finlets, usually 9; anal fin with 16 to 20 rays, usually 18 or 19, followed by 7 to 10 finlets, usually 8; pectoral fin rays 21 to 23. Lateral line abruptly curving downward below second dorsal fin. Vertebrae 16 or 17 precaudal plus 24 to 26 caudal; total 41 to 43, usually 42. Intestine with 2 folds and 3 limbs. Colour: sides plain silver without bars or spots, juveniles with bronze spots smaller than the pupil of the eye in five or six irregular rows. Adults have no black area on the anterior part of the first dorsal fin as have many species of Scomberomorus.

**Geographical Distribution :** Western Atlantic from Massachusetts to Rio de Janeiro, Brazil (Collette & Russo, 1979:fig. 9). The coastal area from Florida to Massachusetts is inhabited only during the warm months of the year.




**Habitat and Biology :** An epipelagic, neritic species, often found in outer reef areas. The larvae are encountered in surface waters of 26.3° to 31.0°C and 26.9 to 35.0°/ooS (McEachran, Finucane & Hall, 1980). King mackerel appear to be present throughout the year off Louisiana and off the state of Ceará in northeastern Brazil. There also seems to be some resident populations in South Florida waters, as fish are available to the recreational fishery all around the year. However, large schools of similar-sized king mackerel are found to migrate over considerable distances along the Atlantic US coast, water temperatures permitting.

Spawning takes place from May through September in the western Gulf of Mexico, particularly in September at depths between 35 and 180 m over the middle and outer continental shelf (McEachran, Finucane & Hall, 1980), peaks in July and August in the northeastern Caribbean (Erdman, 1977), but occurs throughout the year off northeastern Brazil (Ivo, 1972). In Brazil, the fecundity of 63 to 123 cm long females ranges from 345 000 to 2 280 000 eggs (Ivo, 1974).

As in other members of the genus, food consists primarily of fishes with smaller quantities of penaeid shrimps and squids (De Vane, 1978). Clupeids such as Opisthonema, Harengula and Brevoortia are particularly important, even in juveniles of fork lengths between 10 and 31 cm (Naughton & Salomon, 1981). Other fishes commonly preyed upon include jack mackerels (Carangidae), snappers (Lutjanidae), grunts (Pomadasyidae) and half-beaks (Hemiramphidae).

**Size :** Maximum size is 173 cm fork length and 45 kg weight; common to 70 cm fork length; off northeastern Brazil, length in the catches ranges mostly between 50 and 90 cm. The all-tackle angling record is a 40.8 kg fish with a fork length of 170 cm taken at Key West, Florida, in 1976. In Florida, fork length at first maturity is 73 cm in males and 84 cm in females (Beaumariage, 1973). In Brazil, females mature at about 77 cm (Ivo, 1972).

**Interest to Fisheries :** King mackerel is an important species for recreational, commercial and artisanal fisheries throughout its range. The catch reported from Fishing Area 31 totalled 7 375 metric tons in 1981 (FAO, 1983), but is probably higher, since part of the additional 1 100 metric tons of unclassified Scomberomorus species is likely to be S. cavalla and since reporting on the considerable recreational catch is inadequate (Manooch, 1979). It is also suspected that some of the catch reported as S. maculatus by Cuba and the Dominican Republic may in fact be S. cavalla or S. regalis.

In the USA, sport fishing with hook-and-line is carried out from April to December (but mostly in spring and fall) in North Carolina, and all year round (with local seasonal peaks) in Florida. Commercial fisheries operate in the same areas, as well as off Louisiana and Mississippi. Fishing gear include hook-and-line (North Carolina), snapper hooks and line (Mississippi), gillnets (southern Florida and North Carolina), and either trolled lure or small bait in the charter boat industry (Florida). The gillnet fishery has employed power block retrieval since 1963, and aerial spotting is sometimes used (Beaumariage, 1973).

King mackerel is the main Scomberomorus species of interest to the commercial fishery that extends throughout the year off northeastern Brazil (Nomura & Rodrigues, 1967). The major Brazilian fishing grounds are located some 6 to 16 miles off the coastline. Gillnets take mostly 2 to 4 year old fish (88%), whereas trolling lines catch predominantly 4 to 6 year old individuals (Alcantara Filho, 1972). Fishing is also carried out from rafts with hooks baited with thread herring. Most of the catch is generally processed into steaks or sold fresh (Lyles, 1969), but it has also been canned and salted (Bustos et al., 1973; Paiva & Costa, 1966) in northeastern Brazil.

**Local Names :** BRAZIL: Cavala; CUBA: Serrucho, Sierra; DOMINICAN REPUBLIC: Sierra; FRENCH GUAYANA: Maquereau; GERMAN DM RP: Königsmakrele; ITALY: Sgombro reale; PORTUGAL: Cavala, Cavala inpigem, Cavala verdadeira; PUERTO RICO: Carite; USA: Kingfish, King mackerel; USSR: Korolevskaya makrel; VENEZUELA: Carite lucio, Carite sierra, Rey.

**Literature :** Nomura & Rodrigues (1967, Brazil); Menezes (1969, food, Brazil); Alcantara Filho (1972a); Beaumariage (1973, Florida); Berrien & Finan (1977); Collette (1978, Species Identification Sheets, Western Central Atlantic); Manooch, Nakamura & Hall (1978, bibliography); Trent et al. (1981, southeastern USA); Ximenes, Menezes & Fonteles-Filho (1981, length-weight relationship, Brazil).

**Scomberomorus commerson** (Lacepède, 1800)

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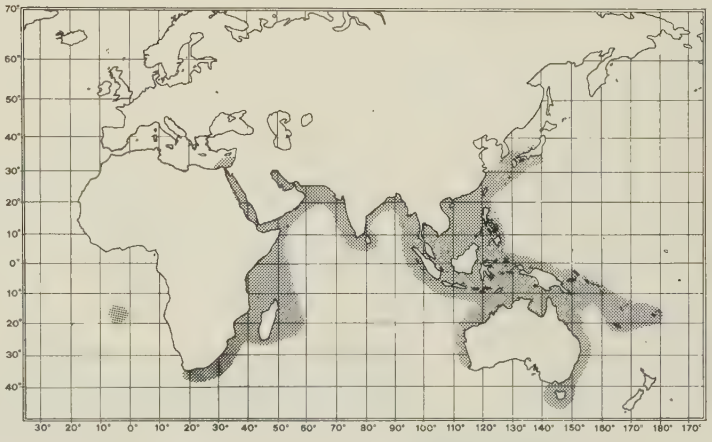
Scomber commerson Lacepède, 1800, Histoire Naturelle des Poissons, 1:598, 600-603, pl. 20 (fig. 1) (based on a figure from Commerson's manuscripts).

**Synonymy :** Scomber commersonii - Shaw, 1803; Scomber maculosus Shaw, 1803; Cybium commersonii - Cuvier, 1829; Cybium konam Bleeker, 1851a; Scomberomorus commersoni - Jordan & Seale, 1906; Cybium multifasciatum Kishinouye, 1915.

**FAO Names :** En - Narrow-barred Spanish mackerel; Fr - Thazard rayé (Indo-Pacifique); Sp - Carite estriado.

**Diagnostic Features :** Gillrakers on first arch few: 0 to 2 on upper limb; 1 to 8 on lower limb; 1 to 8 total. First dorsal fin with 15 to 18 spines, usually 16 or 17; second dorsal with 15 to 20 rays, usually 17 or 18, followed by 8 to 10 finlets; anal fin with 16 to 21 rays, usually 18 or 19 followed by 7 to 12 finlets, usually 9 or 10; pectoral fin rays 21 to 24. Lateral line abruptly bent downward below end of second dorsal fin. Vertebrae 19 or 20 precaudal plus 23 to 27 caudal, total 42 to 46. Intestine with 2 folds and 3 limbs. Colour: sides silvery grey marked with transverse vertical bars of a darker grey; bars narrow and slightly wavy, sometimes breaking up into spots ventrally; bars number 40 to 50 in adults but are usually fewer than 20 in juveniles up to 45 cm fork length; cheeks and lower jaw silvery white; first dorsal fin bright blue rapidly fading to blackish blue; pectoral fin light grey turning to blackish blue; caudal fin lobes, second dorsal, anal, and dorsal and anal finlets pale greyish white turning to dark grey. Juveniles have the anterior membranes of the first dorsal jet black contrasting with pure white posteriorly.

**Geographical Distribution :** Widespread throughout the Indo-West Pacific from South Africa and the Red Sea east through the Indo-Australian Archipelago to Australia and Fiji and north to China and Japan (Collette & Russo, 1979:fig. 9). A recent immigrant to the eastern Mediterranean Sea by way of the Suez Canal.



**Habitat and Biology :** An epipelagic, neritic species known to undertake lengthy longshore migrations (Lewis, 1981), but permanently resident populations also seem to exist. Migrations extend along the entire east coast of Queensland (McPherson, 1981). The migration route in the Gulf of Thailand has been mapped by Tongyai (1970).

Depending on temperature regime, the spawning season may be more or less extended. In east Africa it extends from October to July, off Madagascar from December to February, in the coastal waters off Madras State from May to July (Chacko, Thomas & Pillay, 1968), off Taiwan Island in spring, off Papua New Guinea from July to December (Lewis, Smith & Kearney, 1974), on the Great Barrier Reef from October to December (Munro, 1947), and around Fiji from October to February with peaks in December and January (Lewis, Chapman & Sesewa, 1983).

Like other species of the genus, S. commerson feeds primarily on small fish, particularly anchovies such as Anchoviella and Stolephorus, and clupeids such as Sardinella (Chacko, Thomas & Pillay, 1968; Prado, 1970; Merçeron, 1970; van der Elst, 1981). Other prey include small carangids, slipmouths (Leiognathus), squids (i.e. Loligo) and penaeoid shrimps. Feeding apparently takes place day and night.

**Size :** Maximum fork length is about 220 cm, common to 90 cm. The all-tackle angling record is a 44.9 kg fish taken off Scottburgh, Natal, South Africa, in 1982. The smallest mature males and females had fork lengths between 65 and 70 cm respectively (Lewis, Chapman & Sesewa, 1983).

**Interest to Fisheries :** This species is taken throughout its range by commercial, artisanal, and recreational fisheries. There are important fisheries in three Fishing Areas: 51, 57 and 71. The world catch increased from 55 452 metric tons in 1978 to 72 281 metric tons in 1981 (FAO, 1983). The five countries with the largest reported catch in this period were Indonesia, Philippines, Sri Lanka, Democratic Yemen, and Pakistan. Approximately 1 000 tons a year are landed in Queensland, Australia (McPherson, 1981), while the 1982 catch in Fiji probably exceeded 300 tons (Lewis, Chapman & Sesewa, 1983). There is also an important drift-net (gillnet) fishery in India but the catch is not identified to species in the statistics. In Thailand and Malaysia drift nets also seem to be the most important gear deployed to catch this species. Other gear include shore seines in Taiwan (Province of China) and India; trolling lines on Taiwan Island, in Malaysia and in east Africa, where it is a priced market fish, and handlines (bett-tok) baited with mackerel or squid (Rastrelliger and Loligo) and trolling lines (bett-laak) with spoons in the Gulf of Thailand (Tongyai, 1970). In Samoa it is sold fresh and canned.

The fishing seasons change according to differential availability of fish as a function of variation in hydrographical conditions and weather conditions for fishing. They peak from August to September on the Great Barrier Reef, in spring off the island of Taiwan, in the dry season between October and April/May off Kampuchea and in the Gulf of Thailand, in March/April, June/July, and December in northeastern India, from September to April in southeastern India, and in February/March, and October to December off the southwestern coast of India, south of Bombay. It is marketed fresh, on ice, or salted and dried.

**Local Names :** AUSTRALIA: Narrowbarred mackerel, Doggie, Kingfish, Snook; BANGLADESH: Champa, Matia; FIJI: Walu; GERMANY FR: Spanische Makrele; INDIA: Ah-ku-lah (Tamil), Ayakora, Chumbum (Malayalam), King seer, Konam (Tamil), Konema (Tellugu), Mah-wu-leachi (Tamil), Yellari (Tellugu); INDONESIA: Tenggirri; JAPAN: Yokoshimasawara; KENYA: Nguru, Nguru-mtwane (Swahili); MADAGASCAR: Angoho, Lamatra; PACIFIC ISLANDS TRUST TERRITORIES: Palau: Ngelngal; PHILIPPINES: Maladyong, Tangigi, Tanguigue, Tanigi; SOMALIA: Nguru, Nguru-mtwane (Swahili); SOUTH AFRICA: Katonkel, King mackerel; SRI LANKA: Barred Spanish mackerel, Konam (Tamil), Striped seer; TANZANIA: Nguru, Nguru-mtwane (Swahili); THAILAND: Insi, Thu insi; USSR: Dairek, Ispanskaya makrel, Korolevskaya pyatnistaya makrel, Poperechnopolosataya pelamida, Sierra, Uzkopolosaya makrel.

**Literature :** Prado (1970, Madagascar); Tongyai (1970, Thailand); Fischer & Whitehead, eds (1974, Species Identification Sheets, Eastern Indian Ocean/Western Central Pacific); Devaray (1977, 1982, India); McPherson (1981, Australia); Lewis, Chapman & Sesewa (1983).

**Remarks :** A lipid-soluble toxin, similar to ciguatoxin has been found in the flesh of S. commerson caught between 24° and 26°S on the east coast of Queensland (Lewis & Endean, 1983). At least 38 toxic individuals, resulting in 217 poisonings, came from this area.

**Scomberomorus concolor** (Lockington, 1879) | SCOMBR Scombm 8

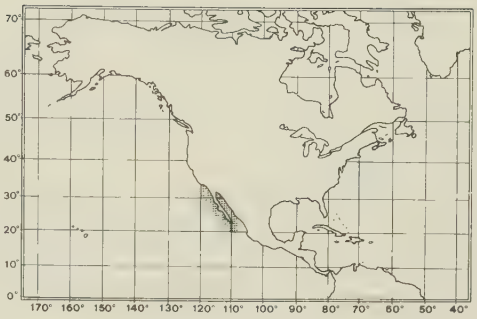
Chriomitra concolor Lockington, 1879:134-136 (Monterey Bay, California).

**Synonymy :** Scomberomorus concolor - Jordan & Gilbert, 1882.

**FAO Names :** En - Monterey Spanish mackerel; Fr - Thazard de Monterey; Sp - Carite de Monterey.

**Diagnostic Features :** Gillrakers on first arch many: 4 to 8 on upper limb; 15 to 21 on lower limb; 21 to 27 total. First dorsal fin with 15 to 18 spines, usually 17; second dorsal with 16 to 20 rays, usually 18 or 19, followed by 6 to 9 finlets, usually 8; anal fins with 19 to 23 rays, usually 20; followed by 6 to 8 finlets; pectoral fin rays few 19 to 22, usually 21. Lateral line gradually curving down toward caudal peduncle. Vertebrae 18 to 20 precaudal plus 27 to 29 caudal, total 46 to 48, usually 19 plus 28 total 47. Intestine with 2 folds and 3 limbs. Colour: males steel blue on back, silvery on sides and below, without streaks or spots. Females darker, with two alternate series of brown spots (gold in life) on sides.

**Geographical Distribution :** Eastern subtropical Pacific (Collette & Russo, 1979:fig. 8), now confined to the northern Gulf of California temperate waters.



**Habitat and Biology :** An epipelagic, neritic species. It is now extinct outside the Gulf of California. Its biology is almost completely unknown.

**Size :** Maximum size is about 76 cm fork length and 3.6 kg.

**Interest to Fisheries :** Monterey Spanish mackerel was taken in commercial quantities in the 1870's and 1880's. There is a substantial gillnet fishery for this species in the northwestern Gulf of California estuaries and marshes. This fishery operates on a relict of the original population.

**Local Names :** MEXICO: Sierra; USA: Gulf sierra; USSR: Kalifornijskaya korolevskaya makrel.

**Literature :** Fitch & Flechsig (1949).

**Scomberomorus guttatus** (Bloch & Schneider, 1801) SCOMBR Scombm 3

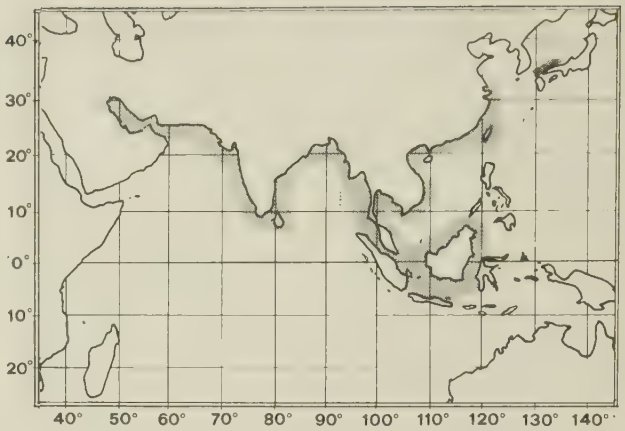
Scomber guttatus Bloch & Schneider, 1801, Systema Ichthyologiae:23-24, pl. 5 (Tranquebar, India).

**Synonymy :** Scomber leopardus Shaw, 1803; Cybium guttatum - Cuvier, 1829; Cybium interruptum Cuvier in Cuvier & Valenciennes, 1831; Cybium kuhlii Cuvier in Cuvier & Valenciennes, 1831; Cybium crockewitii Bleeker, 1851; Scomberomorus guttatus - Fowler, 1905; Scomberomorus guttatum - Malpas, 1926; Scomberomorus kuhlii - Chevey, 1934; Scomberomorus crockewiti - Beaufort, 1951; Indocybium guttatum - Munro, 1955; Scomberomorus guttatus guttatus - Silas, 1964.

**FAO Names :** En - Indo-Pacific king mackerel; Fr - Thazard ponctué (Indo-Pacifique); Sp - Carite del Indo-Pacífico.

**Diagnostic Features :** Depth of body less than in S. koreanus (22.8 to 25.2% vs 24.4 to 26.7% of fork length). Head larger than in S. koreanus (20.2 to 21.5% vs 19.7 to 20.4% of fork length). Gillrakers on first arch moderate: 1 or 2 on upper limb; 7 to 12 on lower limb; 8 to 14 total. First dorsal fin with 15 to 18 spines, usually 16 or more; second dorsal with 18 to 24 rays, usually 20 to 22, followed by 7 to 10 finlets; anal fin with 19 to 23 rays; followed by 7 to 10 finlets, usually 8; pectoral fin rays few, 20 to 23, modally 21. Lateral line with many fine auxillary branches extending dorsally and ventrally in anterior third, gradually curving down toward caudal peduncle. Vertebrae 19 to 22 precaudal plus 28 to 31 caudal, total 47 to 52, usually 50 or 51. Intestine with 2 folds and 3 limbs. Colour: sides silvery white with several longitudinal rows of round dark brownish spots (smaller than eye diameter) scattered in about 3 irregular rows along lateral line. First dorsal fin membrane black (up to the 8th spine white posteriorly, with the distal margin black; pectoral, second dorsal and caudal fins dark brown; pelvic and anal fins silvery white.

**Geographical Distribution :** Along the shores of continental Indo-West Pacific from Wakasa Bay, Sea of Japan (Nakamura & Nakamura, 1982) and Hong Kong south to the Gulf of Thailand and west to the Gulf lying between the Arabian peninsula and Iran (Collette & Russo, 1979:fig. 10).




**Habitat and Biology :** An epipelagic, neritic species believed to be less migratory than S. commerson that may be encountered in turbid waters with reduced salinity. Movements in the Gulf of Thailand might be deduced from seasonal changes in peak fishing months along the coast of Thailand. These peaks are November/December in eastern Thailand, late December/January in the northern part of the Gulf and January-March in its western part (Tongyai, 1970).

Based on occurrence of ripe females and size of maturing eggs, spawning probably occurs from April to July around Rameswaram Island between India and Sri Lanka (Krishnamoorthi, 1958). Ripe females (32.5 to 46.5 cm fork length) are taken in May in Thai waters.

As with other species of Somberomorus, the food of Indo-Pacific king mackerel consists primarily of fishes. Juveniles in India feed mainly on teleosts, particularly clupeoids such as Anchoviella (Venkataraman, 1961; Kumaran, 1964; Rao, 1964). Adults also prey mainly on fishes with small quantities of crustaceans and squids (Thailand - Tongyai, 1970, India - Rao, 1964). Anchovies are particularly important: Stolephorus in Singapore Straits (Tham, 1950, 1953), Anchoviella in Waltair, India (Rao, 1964).

**Size :** Maximum fork length is 76 cm. Size at first maturity ranges between 48 and 52 cm total length in southern India, and about 40 cm total length in Thailand

**Interest to Fisheries :** There are commercial and artisanal fisheries for S. guttatus in Kampuchea (Merçeron, 1970), Thailand (Tongyai, 1971), Malaysia (Pathansali, 1968), and India, particularly in the lower Sundarbans, West Bengal (Banerjee & Chakrabarty, 1972), around Madras (Vijayaraghavan, 1955), the Gulf of Mannar-Palk Bay area (Krishnamoorthi, 1957), and Malwan, south of Bombay (Kaikini, 1961). These fisheries may be operational throughout the year, but with peaks that differ from region to region in correlation with differential abundance of Indo-Pacific king mackerel.

S. guttatus is one of principal species in the drift net seerfish fishery in India but the catch is not identified to species in the statistics. Indonesia reported between 4 047 and 4 639 metric tons per year in the period from 1978 to 1981 in Fishing Areas 57/71. At the same time vessels from Taiwan (Province of China) caught between 10 838 and 14 699 tons in Area 61 (FAO, 1983).

The primary gear in most areas appears to be the drift gillnet, but the species is also taken in bamboo stake traps and with hand lines in Thailand (Tongyai, 1970), and by trolling or with hook-and-line in India and Malaysia (Jones, 1968; Rao, 1964; Pathansali, 1968). It is utilized fresh or salted in most areas (Kampuchea - Merçeron, 1970; Thailand - Tongyai, 1971; India - Jones, 1968). Although less abundant than the Indian mackerels (Rastrelliger spp.), S. guttatus is highly esteemed for food and commands a higher price in Thailand and India (Tongyai, 1966; Pathansali, 1968).

**Local Names :** AUSTRALIA: Spotted Spanish mackerel; BANGLADESH: Bijram; BURMA: Nga-bu-zin; INDIA: Aya-kora (Malayalam), Jhavar, Seela, Spotted seer, Vanjiram (Tamil), Varimeen (Malayalam); INDONESIA: Ajong-ajong, Tandang, Tengiri; IRAN: Ghobad, Sheer; JAPAN: Taiwansawara; MADAGASCAR: Razandamatra; SRI LANKA: Spotted Spanish mackerel; THAILAND: Insi; UK: Indo-Pacific Spanish mackerel; USSR: Indijskaya makrel, Pyatnistaya ispanskaya makrel, Pyatnistaya pelamida; VIET NAM: Cá thu cham.

**Literature :** Kishinouye (1923, Japan); Fischer & Whitehead, eds. (1974, Species Identification Sheets, Eastern Indian Ocean/Western Central Pacific); Devaraj (1977, 1982, India).

**Scomberomorus koreanus** (Kishinouye, 1915)

SCOMBR Scombm 11

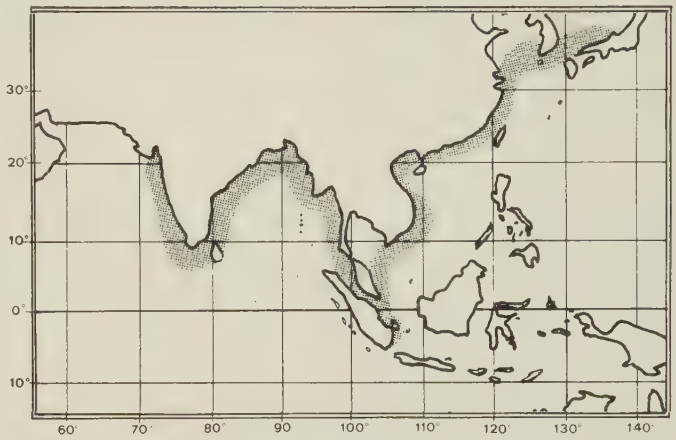
Cybium koreanum Kishinouye, 1915:11, pl 1 (fig. 6) (Korea)

**Synonymy :** Sawara koreanum - Soldatov & Lindberg, 1930; Scomberomorus koreanus - Munro, 1943; Scomberomorus guttatus koreanus - Silas, 1964a.

**FAO Names :** En - Korean seerfish; Fr - Thazard coréen; Sp - Carite coreano.

**Diagnostic Features :** Depth of body greater than in S. guttatus (24.4 to 26.7% vs 22.8 to 25.2% of fork length). Head shorter than in S. guttatus (19.7 to 20.4% vs 20.2 to 21.5% fork of length). Gillrakers on first arch moderate: 1 or 2 on upper limb; 9 to 12 on lower limb; 11 to 15 total. First dorsal fin with 14 to 17 spines, usually 15 or fewer; second dorsal with 20 to 24 rays, followed by 7 to 9 finlets; anal fin with 20 to 24 rays, usually 22 or 23 followed by 7 to 9 finlets; pectoral fin rays 20 to 24, modally 22. Lateral line with many fine auxillary branches extending dorsally and ventrally in anterior third, gradually curving down toward caudal peduncle. Vertebrae 20 precaudal plus 26 or 27 caudal, total 46 or 47, usually 46. Intestine with 4 folds and 5 limbs. Colour: sides silvery white with several longitudinal rows of round dark brownish spots (smaller than eye diameter) rather sparsely scattered along lateral median line; first dorsal fin membrane black; pectoral, second dorsal and caudal fins dark brown; pelvic and anal fins silvery white.

**Geographical Distribution :** Continental Indo-West Pacific from Wakasa Bay, Sea of Japan (Nakamura & Nakamura, 1982), and China south to Singapore and Sumatra and west to Bombay, India (Collette & Russo, 1979:fig. 10).




**Habitat and Biology :** Little is known on the biology of this epipelagic, neritic species. Kishinouye (1923) reported that it spawns in July at the mouth of the Daidoko, Korea and that it feeds on sardines, anchovies and shrimps.

**Size :** Maximum size is 150 cm fork length and 15 kg weight; common to 60 cm. Sexual maturity is reached at about 75 cm fork length and a weight of 2.25 kg.

**Interest to Fisheries :** Korean seerfish is usually not distinguished from other species of seerfishes, but makes up an important part of the drift net fishery in Palk Bay and the Gulf of Mannar between southwestern India and Sri Lanka (Devaraj, 1976).

India reported unspecified catches of Scomberomorus ranging between 17 780 metric tons in 1978 and 25 900 metric tons in 1981 (FAO, 1983), part of which was S. koreanus.

**Local Names :** CHINA: Compressed mackerel, Korean mackerel; JAPAN: Hirasawara; USSR: Avstralijskaya korolevskaya makrel; Korejskaya makrel; VIET NAM: Cá thu Trieu-tiên.

**Literature :** Kishinouye (1923, Japan); Devaraj (1976, 1977, India).

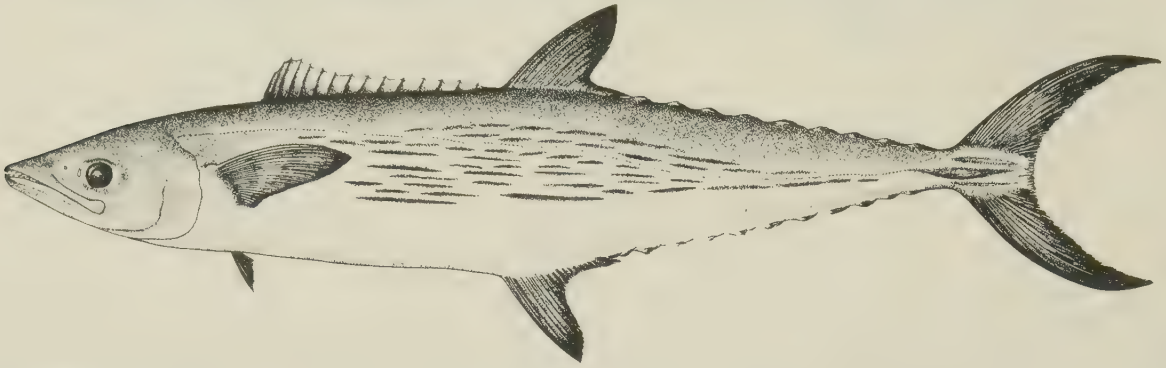
**Remarks :** Devaraj (1976) has recently shown that S. koreanus is a valid species, distinct from S. guttatus.

**Scomberomorus lineolatus** (Cuvier, 1831) | SCOMBR Scombm 2

Cybium lineolatum Cuvier in Cuvier & Valenciennes, 1831, Histoire Naturelle des Poissons, 8:170-172 (Malabar, India).

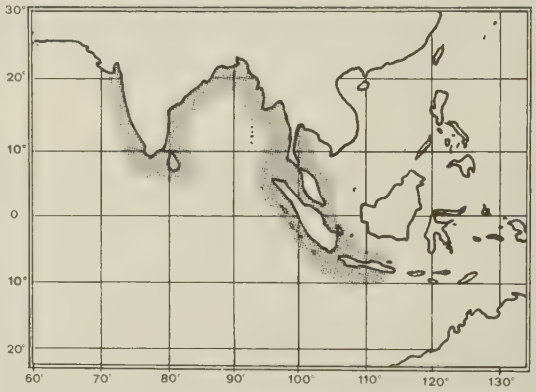
**Synonymy :** Scomberomorus lineolatus - Munro, 1943; Indocybium lineolatum - Munro, 1955.

**FAO Names :** En - Streaked seerfish; Fr - Thazard cirrus; Sp - Carite rayado.



**Diagnostic Features :** Gillrakers on first arch moderate: 1 or 2 on upper limb; 6 to 11 on lower limb, usually 8 to 10; 7 to 13 total. First dorsal fin with 15 to 18 spines, usually 16 or 17; second dorsal with 15 to 19 rays, rarely 21 or 22, usually 17 or 18, followed by 7 to 10 finlets, usually 9; anal fin with 17 to 22 rays, usually 20, followed by 7 to 10 finlets; pectoral fins covered with scales; pectoral fin rays 20 to 24, modally 23. Lateral line without auxillary branches anteriorly, running almost straight below second dorsal finlet, then slightly bent downward toward keel of caudal peduncle (which is very wide). Vertebrae 18 to 20 precaudal plus 25 to 28 caudal, total 44 to 46. Intestine with 2 folds and 3 limbs. Colour: sides silvery marked with series of irregular, horizontal, narrow black lines and few if any spots; first dorsal fin black anteriorly, white posteriorly.

**Geographical Distribution :** Indo-West Pacific from the Gulf of Thailand and Java west to Bombay, India (Collette & Russo, 1979: fig. 11).




**Habitat and Biology :** The biology of this epipelagic, neritic species is poorly known. Unlike S. commerson and S. guttatus it is not encountered in very turbid waters or much reduced salinity. From single records, the reproductive season is deduced to be in fall including October off southern India (Malpas, 1926), and in winter (including January) in the south-eastern Gulf of Bengal (Tongyai, 1966b). Juveniles in India are found to feed on teleosts (Venkataraman, 1961; Rao, 1964).

**Size :** Maximum fork length is 80 cm.

**Interest to Fisheries :** There are small fisheries for S. lineolatus in the waters around Thailand, Malaysia, and India. It is taken from October to November along the Thai coast of the Indian Ocean (Tongyai, 1970), but is less abundant than either S. commerson or S. guttatus in both this area and the Gulf of Thailand (Tongyai, 1970). Streaked seerfish is fished along both coasts of Peninsular Malaysia; along the west coast from November to February in the north and March to July in the south, and on the east coast from February to March and August to November. Fishing is mainly by gillnets, but on the east coast hand lines and trolling lines are also important (Pathansali, 1968). In India, there is an important coastal fishery for the three species of seerfishes that are much in demand, both fresh and salt-cured, although they form a smaller proportion of the catch in India than mackerels (Rastrelliger spp.). S. lineolatus is the least common of these seerfishes. Small individuals, up to 50 cm, are taken, together with S. commerson and S. guttatus, from May to September in gillnets 5 to 12 miles off Tuticorin in the Gulf of Mannar, India. Gillnets, hook-and-line, and trolling lines are the most important gear types in India (Silas, 1968). Scomberomorus spp. are highly esteemed foodfishes in Thailand and are consumed as spicy fish-balls or high quality salted fish. A monthly average of approximately 100 metric tons, fresh or salted, is consumed in Bangkok alone (Tongyai 1966a).

**Local Names :** INDIA: Streaked seer; SOUTH AFRICA: Queen mackerel, Spikkel-katonkel; SRI LANKA: Streaked Spanish mackerel; THAILAND: Pla in-see; USSR: Makrel kanadi.

**Literature :** Fischer & Whitehead, eds (1974, Species Identification Sheets, Eastern Indian Ocean/Western Central Pacific); Devaraj (1977, 1982, India).

**Remarks :** The east African population referred to as S. lineolatus is a distinct species, S. plurilineatus. The Thai vernacular name, pla in-see, applies for all species of the genus.

**Scomberomorus maculatus** (Mitchill, 1815)

SCOMBR Scombm 5

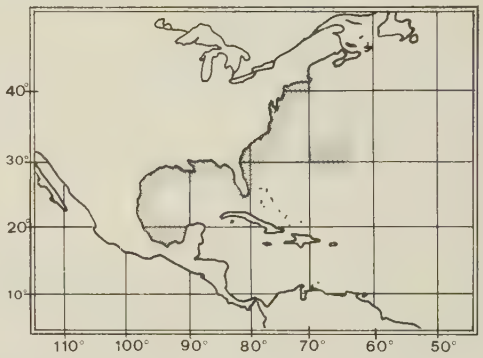
Scomber maculatus Mitchill, 1815, Trans.Lit.Phil.Soc.New York, 1:426-427, pl. 6 (fig. 8) (New York)

**Synonymy :** Cybium maculatum - Cuvier, 1829; Scomberomorus maculatus - Jordan & Gilbert, 1882.

**FAO Names :** En - Atlantic Spanish mackerel; Fr - Thazard atlantique; Sp - Carite atlántico.

**Diagnostic Features :** Gillrakers on first arch moderate: 1 to 4 on upper limb; 8 to 13 on lower limb, usually 10 or 11; 10 to 16 total. First dorsal fin with 17 to 19 spines; second dorsal with 17 to 20 rays, usually 18 or more, followed by 7 to 9 finlets; anal fin with 17 to 20 rays, followed by 7 to 10 finlets; pectoral fin rays 20 to 23, modally 21. Lateral line gradually curving down toward caudal peduncle; pelvic fins relatively long, 4.6 to 5.8% of fork length, compared to S. brasiliensis (3.6 to 5.9%). Vertebrae 21 or 22 precaudal plus 30 or 31 caudal, total 51 to 53. Intestine with 2 folds and 3 limbs. Colour: sides silvery marked with about three rows of round to elliptical dark spots (orange in life); first dorsal fin black anteriorly and at distal margin posteriorly, basal part of posterior membranes white.

**Geographical Distribution :** Seasonal along Atlantic coast of the United States from Cape Cod to Miami and Gulf of Mexico coast from Florida to Yucatan.




**Habitat and Biology :** An epipelagic, neritic species known to migrate in large schools over great distances along the shore. With increasing water temperatures, Atlantic Spanish mackerel move northward, from Florida along the Atlantic coast of the USA to Narraganset Bay, Rhode Island, between late February and July, and back in fall. It overwinters off Florida. There are also schools migrating westwards in early spring, reaching Texas in late March. North-south movements along the Mexican coast occur between August and November and back in March and April.

S. maculatus spawn in batches from May to September in waters of less than 50 m depth over the inner continental shelf of Texas, from July to September (or as early as April in some years) off Florida, starting in April off the Carolinas, and from late August to late September in the northernmost part of its range. Larvae have been encountered in surface waters with temperature ranging between 19.6° and 29.8°C and salinities of 28.3 to 37.4°/ooS (McEachran, Finucane & Hall, 1980).

As with other members of the genus, food consists mainly of small fishes with lesser quantities of penaeoid shrimps and cephalopods. Clupeoids such as menhaden, alewives, thread herring (Opisthonema), and anchovies (Anchoa) are particularly important forage in North Carolina, Florida, Texas, and Veracruz. The percentage of anchovies consumed is higher for juveniles than for adults.

**Size :** Maximum size is about 77 cm fork length and 4.8 kg weight (Beardsley & Richards, 1970). Females grow larger than males. The all-tackle angling record is a 4.02 kg fish with a fork length of 83 cm taken at Kitty Hawk, North Carolina in June 1982. In Florida, females attain sexual maturity between 25 and 37 cm fork length, males between 28 and 34 cm (Klima, 1959).

**Interest to Fisheries :** The Atlantic Spanish mackerel is a valued fish to recreational or commercial fisheries throughout its range. The fisheries along the Atlantic US coast north of southern Florida, and in the Gulf of Mexico are seasonal between spring and late summer or fall, depending on species migrations, while in southern Florida operations are concentrated in the winter months, from October to February or March (Klima, 1959). Since 1950, over 92% of the total US catch has been landed in Florida (Trent & Anthony, 1979). The species is second in volume among Mexico's Gulf of Mexico fisheries with an average annual production of 4 900 metric tons in the period from 1968 to 1976 (Doi & Mendizabal, 1979), most of which is landed in the state of Veracruz (80%).

Catches from Campeche amounted to 15%, and those from Yucatan to 5% of the Mexican total. After substracting the catches reported as S. maculatus that should be attributed to S. brasiliensis, S. cavalla, and S. regalis (in the case of catches reported by Cuba and the Dominican Republic), the world catch of Atlantic Spanish mackerel ranged between about 15 000 metric tons in 1975 and 14 000 metric tons in 1981 (FAO, 1983).

The early fishery in the USA utilized trolling lines, gillnets, and pound nets (Earll, 1883). Fish taken by the commercial gillnet fishery in Florida range between 30 and 65 cm fork length, larger than hook-and-line caught-fish (21 to 69 cm fork length). The minimum acceptable fork length in those days was 30 cm. Gillnet catches comprised predominantly 3 year old fish from 36 to 41 cm fork length (Klima, 1959). Larger vessels now entering the fishery have power-rollers to mechanically retrieve the nets which are mostly made of nylon; airplane spotter pilots locate the fish (Trent & Anthony, 1979). Recreational anglers catch Spanish mackerel from boats while trolling or drifting and from boats, piers, jetties, and beaches by casting, livebait fishing, jigging, and drift fishing (Trent & Anthony, 1979). Fishermen in Veracruz employ beach seines (chinchorros playeros), gillnets (redes agalleras), trolling lures (curricanes), and trap nets (almadrabas).

Nearly all the catch is consumed fresh, frozen, or smoked (Lyles, 1969). A few attempts have been made at canning Atlantic Spanish mackerel but the product has not been widely accepted (Lyles, 1969). Frozen fish begin to show signs of rancidity after as little as three months time in frozen storage. Therefore, they are now being treated with antioxidants and EDTA (Farragut, 1972; Hale, 1979).

**Local Names :** COLOMBIA: Sierra; CUBA: Sierra; GERMAN DM RP: Gefleckte Königsmakrele; MEXICO: Carite, Pintada; POLAND: Makrela hiszpanska; SOUTH AFRICA: Spaanse makriel, Spanish mackerel; USA: Spanish mackerel; USSR: Ispanskaya makrel, Korolevskaya pyatnistaya makrel, Pyatnistaya makrel; VENEZUELA: Carite, Sierra pintada.

**Literature :** Earll (1883); Klima (1959, Florida); Mendoza (1968, Mexico); Alcantara (1972); Márquez (1973, Mexico); Powell (1975, Florida); Berrien & Finan (1977a); Collette (1978, Species Identification Sheets, Western Central Atlantic); Fritzsche (1978, on larvae and juveniles).

**Remarks :** Three other species have been confused with S. maculatus by some workers, S. tritor in the eastern Atlantic, S. sierra in the eastern Pacific, and S. brasiliensis along the Caribbean and Atlantic coasts of Middle and South America.

**Scomberomorus multiradiatus** Munro, 1964

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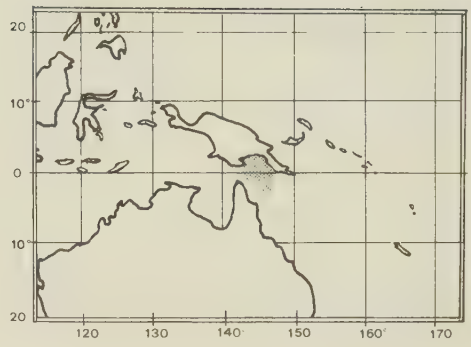
Scomberomorus multiradiatus Munro, 1964, Papua New Guinea Agricult.J., 16(4):168-169, fig. 12 (off mouth of Fly River, Gulf of Papua).

**Synonymy :** None.

**FAO Names :** En - Papuan seerfish; Fr - Thazard papou; Sp - Carite papuense.

**Diagnostic Features :** Gillrakers on first arch few: none on upper limb; 1 to 4 on lower limb; 1 to 4 total. First dorsal fin with 16 to 19 spines, usually 18; second dorsal fin with 21 to 25 rays, followed by 7 to 9 finlets; anal fin with 25 to 29 rays, the highest number in the genus, followed by 6 to 9 finlets, usually 6; pectoral fin rays 20 to 23. Lateral line gradually curving down toward caudal peduncle. The most vertebrae in the genus, 20 or 21 precaudal plus 34 to 36 caudal, total 54 to 56. Intestine with 2 folds and 3 limbs. Colour: sides silvery without spots, blotches, or bars; first dorsal fin black anteriorly and along distal edge posteriorly with some white at posterior base of fin.

**Geographical Distribution :** Restricted to the Gulf of Papua off the mouth of the Fly River.




**Habitat and Biology :** An epipelagic, neritic species found in turbid waters. Nothing is known about its biology.

**Size :** Maximum fork length is 35 cm, weight 0.5 kg, the smallest species in the genus. Sexual maturity is attained at much less than 30 cm fork length.

**Interest to Fisheries :** Papuan seerfish is trawled in the Gulf of Papua but lacks commercial significance.

**Literature :** Lewis (1981).

**Scomberomorus munroi** Collette & Russo, 1980

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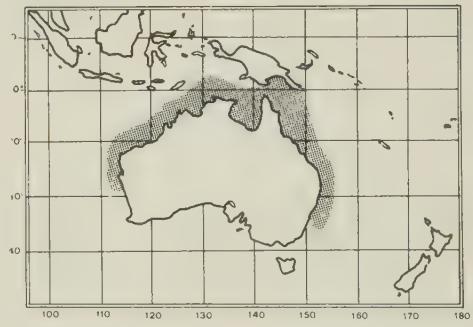
Scomberomorus munroi Collette & Russo, 1980, Austral.J.Mar.Freshwater Res., 31:241-248, fig. 1a (Queensland, Australia).

**Synonymy :** None.

**FAO Names :** En - Australian spotted mackerel; Fr - Thazard australien; Sp - Carite australiano.

**Diagnostic Features :** Gillrakers on first arch moderate: 2 on upper limb; 8 to 10 on lower limb; 10 to 12 total. First dorsal fin with 20 to 22 spines; second dorsal with 17 to 20 rays, followed by 9 or 10 finlets; anal fin with 17 to 19 rays, followed by 8 to 10 finlets; pectoral fin rays 21 to 23. Lateral line gradually curving down toward caudal peduncle. Vertebrae 21 or 22 precaudal plus 28 to 30 caudal, total 50 to 52. Intestine with 2 folds and 3 limbs. Colour: sides with several poorly defined rows of round spots, larger than pupil but smaller than diameter of eye (S. niphonius has more numerous smaller spots, usually about size of pupil); inner surface of pectoral fin dark blue, cheeks and belly silvery white, anal fin light silvery grey, and anal finlets silvery grey; first dorsal fin black (bright steely blue in fresh specimens) with blotches of white toward bases of more posterior membranes in some specimens; membranes entirely black in some specimens. Most other species of Scomberomorus have more extensive white areas on posterior half or middle third of dorsal fin.

**Geographical Distribution :** Restricted to the northern coast of Australia from the Abrolhos Islands region of Western Australia to Coffs Harbour and Kempsey in central New South Wales and the southern coast of Papua New Guinea from Kerema to Port Moresby (Collette & Russo, 1980:fig. 3).




**Habitat and Biology :** An epipelagic, neritic species that forms large schools, which move close inshore along the coast of Queensland, commonly taken between December and April or May (Grant, 1982). Other biological information on this species was not available to the authors.

**Size :** Maximum size is 100 cm fork length and approximately 8 kg in weight, more commonly 50 to 80 cm and 4.5 kg weight (Lewis, 1981). Fork length at first maturity ranges between 50 and 55 cm (A.D. Lewis, pers.comm.).

**Interest to Fisheries :** Four species of Scomberomorus, including S. munroi, and Grammatorcynus form Queensland's second most important fin fishery with an annual production of about 1 000 metric tons of whole and filleted fish. The best catches are made by drifting or anchoring over inshore Queensland reefs and fishing with lines baited with small fish on a gang of 3 or 4 linked hooks (Grant, 1982). Australian spotted mackerel is also taken by trawlers in the Gulf of Papua.

**Local Names :** AUSTRALIA: Queensland: Spotted mackerel.

**Literature :** Munro (1943, as S. niphonius); Grant (1978); Collette & Russo (1980); Lewis (1981); Grant (1982).

**Remarks :** Previous to its description in 1980 the species was confused with S. niphonius.

**Scomberomorus niphonius** (Cuvier, 1831) | SCOMBR Scombm 14

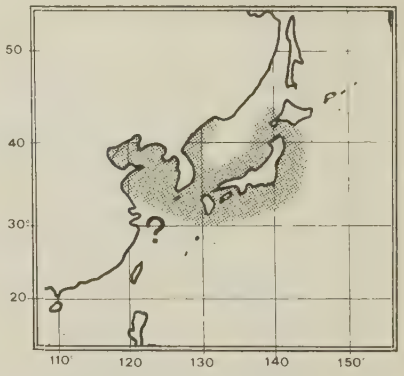
Cybium niphonium Cuvier in Cuvier & Valenciennes, 1831, Histoire Naturelle des Poissons, 8:180-181 (Japan).

**Synonymy :** Cybium gracile Günther, 1873; Scomberomorus niphonius - Jordan, Tanaka & Snyder, 1913; Sawara niphonia - Jordan & Hubbs, 1925.

**FAO Names :** En - Japanese Spanish mackerel; Fr - Thazard oriental; Sp - Carite oriental.

**Diagnostic Features :** Gillrakers on first arch moderate: 2 or 3 on upper limb; 9 to 12 on lower limb; 11 to 15 total. First dorsal fin with 19 to 21 spines; second dorsal with 15 to 19 rays, followed by 7 to 9 finlets; anal fin with 16 to 20 rays, followed by 6 to 9 finlets; pectoral fin rays 21 to 23. Lateral line gradually curving down toward caudal peduncle. Vertebrae 21 to 23 precaudal plus 27 or 28 caudal, total 48 to 50, usually 49. The only species in the genus with a straight intestine. Colour: sides with 7 or more rows of longitudinal spots on the sides; some spots connected together; spots more numerous and smaller than in S. munroi, about pupil size; anterior quarter of first dorsal fin and a narrow distal margin of the rest of the dorsal fin black, most of basal membranes of posterior three quarters of fin white.

**Geographical Distribution :** Confined to the subtropical and temperate waters of China, the Yellow Sea and Sea of Japan north to Vladivostock, USSR (Collette & Russo, 1980:fig. 3).




**Habitat and Biology :** S. niphonius is an epipelagic, neritic species, carrying out a spawning migration in spring (March to June) and a feeding migration in fall (September to November) in the Inland Sea of Japan (Hamada & Iwai, 1967). Spawning extends from April to May with medium-sized fish producing some 550 000 to 870 000 eggs (Kishinouye, 1923). No detailed food studies are available, but the species is known to prey on small fishes.

**Size :** Maximum size is 100 cm fork length and approximately 4.5 kg in weight.

**Interest to Fisheries :** Japanese Spanish mackerel is taken throughout its range, but is the most important Scomberomorus species in Japan. The world catch reported by China, Japan and the Republic of Korea fluctuated between 42 800 metric tons in 1975 and 68 300 metric tons in 1981 (FAO, 1983). Drift gillnets and set nets are the major fishing gears in the seasonal fishery in the Inland Sea of Japan operational from March to June and from September to November. The fish are primarily marketed fresh, and are especially tasty in winter.

**Local Names :** AUSTRALIA: Japanese Spanish mackerel, Spotted Spanish mackerel; JAPAN: Sagoshi, Sawara; USSR: Melkopyatnistaya makrel, Yaponskaya korolevskaya makrel; VIET NAM: Cá thu áu Cham xanh.

**Literature :** Kishinouye (1923); Hamada & Iwai (1967, age and growth studies); Kim (1970), Liu, Zhang & Yang (1982); Wang (1982).

**Remarks :** The Spanish mackerel found along the northern coast of Australia and the southern coast of Papua New Guinea that has been considered as S. niphonius actually represents a distinct species, S. munroi, as shown by Collette & Russo (1980).

**Scomberomorus plurilineatus** Fourmanoir, 1966

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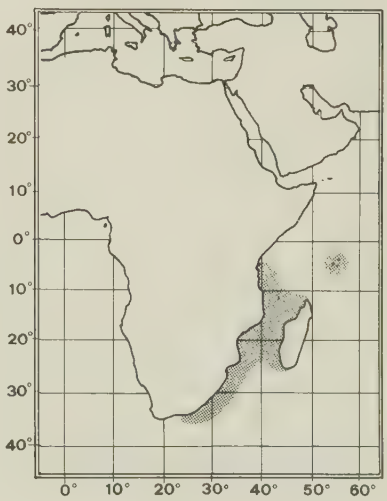
Scomberomorus plurilineatus Fourmanoir, 1966, Bull.Mus.Nat.Hist.Nat., ser. 2, 38(3):223-226, fig. 1 (Madagascar).

**Synonymy :** None.

**FAO Names :** En - Kanadi kingfish; Fr - Thazard Kanadi; Sp - Carite canadí.

**Diagnostic Features :** Gillrakers on first arch moderate: 2 or 3 on upper limb; 9 to 13 on lower limb, usually 10 to 12; 12 to 15 total. First dorsal fin with 15 to 17 spines; second dorsal with 19 to 21 rays, followed by 8 to 10 finlets; anal fin with 19 to 22 rays, followed by 7 to 10 finlets; many pectoral fin rays 21 to 26, modally 23. Lateral line without auxillary branches anteriorly, gradually curving down toward caudal peduncle. Vertebrae 19 or 20 precaudal plus 25 to 27 caudal, total 45 or 46, usually 20 plus 26 total 46. Intestine with 2 folds and 3 limbs. Colour: sides silvery with a series of about 6 to 8 interrupted horizontal black lines, much narrower than interspaces. Anteriorly, usually only one of these lines above lateral line; replaced posteriorly by a number of short oblique black lines becoming somewhat confused, and only 2 or 3 continue through to caudal peduncle. Horizontal black lines on body interrupted to varying degrees, beginning almost intact in places, but broken up into a series of small rectangular "spots" in others. Juveniles have spots but develop adult pattern of interrupted lines by the time they reach a length of 40 cm. Upper areas of caudal peduncle and median keel black, lower areas dusky. First dorsal fin black except lower areas of membrane that may be pale posteriorly. Second dorsal fin with leading edge and tips of rays dusky, rest silver to pale; finlets dusky with a silver area at center. Anal fin, leading edges and tips of rays dusky, rest silvery; finlets white with a dusky central area. Pectoral fins black inside, as is axil; dusky outside with edges black; pelvic fins pale whitish with outside of mid-rays dusky, groove on body a little dusky.

**Geographical Distribution :** Confined to the western Indian Ocean along the coast of East Africa from Kenya and Zanzibar to Algoa Bay, Natal and along the west coast of Madagascar (Collette & Russo, 1979:fig. 11). Also found in the Seychelles.




**Habitat and Biology :** An epipelagic, neritic species present in large schools in the Zanzibar Channel from March or April until August or September (average weights between 3.2 and 3.5 kg) (Williams, 1960). Angling statistics point to a peak abundance in Natal, South Africa during May (Van der Elst, 1981). Spawning probably takes place in August and September in the Zanzibar Channel (Williams, 1964). Kanadi kingfish feed mainly on anchovies (Anchoviella sp.), clupeids (Amblygaster sp., Sardinella fimbriata, S. perforata), other small fishes, squids, and mantis shrimps (Williams, 1964; Merret & Thorp, 1965; Van der Elst, 1981).

**Size :** Maximum fork length is 120 cm. The South African angling record is a 10.0 kg fish. Sexual maturity is attained at about 80 cm fork length (Van der Elst, 1981).

**Interest to Fisheries :** Kanadi kingfish is one of the Tanzanian staple food fishes during the fishing season extending from March or April until August or September in the Zanzibar Channel, where large schools are present. It is caught mostly in gill or set nets, but also on handlines baited with live sardines and by trolling. In the Malindi area of Kenya, Kanadi kingfish continues to be taken mainly by trolling lines and handlines. The species is also important on both sides of the Mozambique Channel south to Durban, and is a popular gamefish of the ski-boat fishermen and spearfishermen in Natal (Van der Elst, 1981).

**Local Names :** MADAGASCAR: NW coast: Tefo; SOUTH AFRICA: Queen mackerel, Spotted mackerel; Natal: Natal snoek.

**Literature :** Williams (1960, under the name of S. lineolatus); Van der Elst (1981).

**Remarks :** This species has been confused with S. lineolatus and with S. guttatus (both under this name and one of its junior synonyms, S. leopardus).

**Scomberomorus queenslandicus** Munro, 1943 | SCOMBR Scombm 16

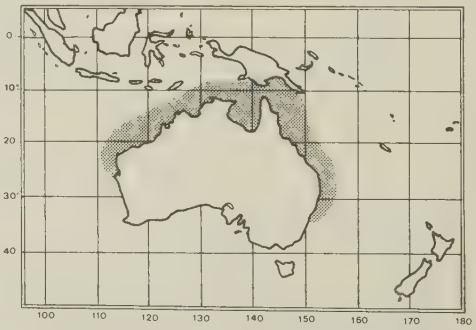
Scomberomorus (Cybium) queenslandicus Munro, 1943, Mem.Queensland Mus. 12(2):82-86, pl. 7 (fig. B), (Cape Cleveland, N. Queensland).

**Synonymy :** None.

**FAO Names :** En - Queensland school mackerel; Fr - Thazard du Queensland; Sp - Carite de Queensland.

**Diagnostic Features :** Gillrakers on first arch few: 0 to 2 on upper limb; 3 to 8 on lower limb; 3 to 9 total, usually 7 or fewer. First dorsal fin with 16 to 18 spines, usually 17; second dorsal with 17 to 19 rays, followed by 9 to 11 finlets; anal fin with 16 to 20 rays, followed by 9 to 11 finlets; pectoral fin rays 21 to 23. Lateral line gradually curving down toward caudal peduncle. Vertebrae 19 or 20 precaudal plus 28 or 29 caudal, total 48 or 49, usually 20 plus 28 total 48. Intestine with 2 folds and 3 limbs. Colour: sides of adults marked with about three indefinite rows of indistinct bronze-grey blotches, each a little larger than orbit; membrane of first dorsal fin jet black with large contrasting areas of intense white between sixth and last spine; second dorsal fin, finlets, and caudal fin pearly grey with darker margins; pelvic fins, anal fin, and anal finlets white; pectoral fins greyish, darkest on inner surface. Characteristic blotches absent in a 9.5 cm juvenile.

**Geographical Distribution :** Largely confined to inshore coastal waters of southern Papua New Guinea and northern and eastern Australia, from Shark Bay and Onslow, western Australia to Sydney, New South Wales (Collette & Russo, 1979:fig. 10).




**Habitat and Biology :** An epipelagic, neritic schooling species moving into inshore waters, bays and estuaries of Queensland during the southern midwinter and early spring (Grant, 1982). It is seasonally migratory in the Gulf of Carpentaria (Rainer & Munro, 1982) and forms mixed schools with S. commerson over shallow reefs offshore of Queensland. Information on spawning, food and feeding habits is lacking.

**Size :** Maximum size is 100 cm fork length and 8 kg in weight, commonly between 50 and 80 cm (Lewis, 1981).

**Interest to Fisheries :** Four species of Scomberomorus, including S. queenslandicus and Grammatorcynus form Queensland's second most important fin-fishery with an annual production of about 1 000 tons of whole and filleted fish. Queensland school mackerel is caught by recreational and commercial line-fishermen trolling with lures including metal spoons, and cut bait. The species is also trawled in the Gulf of Papua.

**Local Names :** AUSTRALIA: Blotched mackerel, Doggie mackerel, Queensland mackerel, School mackerel; USSR: Korolevskaya makrel, Kvinslendskaya makrel.

**Literature :** Munro (1943); Grant (1982).

**Remarks :** Prior to its description, this species was confused with S. guttatus.

**Scomberomorus regalis** (Bloch, 1793)

SCOMBR Scombm 6

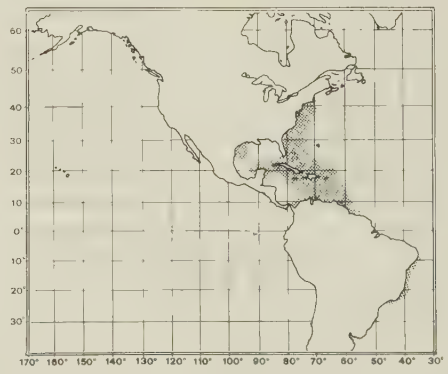
Scomber regalis Bloch, 1793, Naturgeschichte der ausländischen Fische, 7:38-43, pl. 333 (Martinique).

**Synonymy :** Scomberomorus plumierii Lacepède, 1803; Cybium regale - Cuvier, 1829; Scomberomorus regalis - Jordan & Gilbert, 1882.

**FAO Names :** En - Cero; Fr - Thazard franc; Sp - Carite chinigua.

**Diagnostic Features :** Gillrakers on first arch moderate: 2 to 4 on upper limb; 10 to 14 on lower limb; total 12 to 18, usually 15 or 16. First dorsal fin with 16 to 18 spines, usually 17; second dorsal with 16 to 19 rays, followed by 7 to 9 finlets; anal fin with 15 to 20 rays, usually 18 or 19, followed by 7 to 10 finlets, usually 8; pectoral fin covered with small scales; pectoral fin rays 20 to 24, usually 21 or 22; pelvic fins relatively long, 4.4 to 6.3% of fork length, compared to S. brasiliensis (3.6 to 5.9%). Lateral line gradually curving down toward caudal peduncle. Vertebrae 19 or 20 precaudal plus 28 or 29 caudal, total 47 or 48. Intestine with 2 folds and 3 limbs. Colour: sides silvery with one long mid-lateral stripe and with several rows of yellow-orange streaks of variable length and small yellow spots above and below the stripe; anterior third of first dorsal fin black, posterior white.

**Geographical Distribution :** Tropical and subtropical waters of the western Atlantic from Massachusetts to Brazil, particularly in the Bahamas and West Indies (Collette & Russo, 1979:fig. 8).



**Habitat and Biology :** An epipelagic species that is most abundant in the clear waters around coral reefs. Around Puerto Rico, spawning takes place virtually all year (Erdman, 1977), but is restricted to the period from April to October on California Bank, south of Jamaica (Cooper, 1982). Fecundity varies from about 160 000 to 2.23 million eggs in females ranging between 38 and 80 cm fork length (Finucane & Collins, in prep.). In the West Indies, 96% of its food constists of small schooling fishes, particularly clupeoids (Harengula, Jenkinsia, and Opisthonema) and atherinids (Allanetta), but includes also squids and shrimps (Randall, 1967).

**Size :** Maximum size is 83.5 cm fork length and a weight of 4.9 kg (Beardsley & Richards, 1970). Males mature between 32.5 and 34.9 cm fork length, females at about 38 cm (Finucane & Collins, in prep.).

**Interest to Fisheries :** Cero are commercially caught with gillnets and on lines in the West Indies and the Bahamas, and are also valued sportsfish taken by trolling with cut bait in Florida. Only about 100 metric tons identified as S. regalis were reported from Fishing Area 31 in the period between 1975 and 1981, all from the Dominican Republic (FAO, 1983), but the actual catch is higher because up to 1 000 additional metric tons of unidentified Scomberomorus also reported for this area are believed to be mostly S. regalis and S. cavalla. It is also suspected that some of the catches reported as S. maculatus by Cuba and the Dominican Republic are in fact attributable to Cero.

**Local Names :** BRAZIL: Cavala-branca; COLOMBIA: Carite; CUBA: Pintada; DOMINICAN REPUBLIC: Sierra; GERMAN DM RP: Königsmakrele; MARTINIQUE: Thazard franc; MEXICO: Sierra; PUERTO RICO: Sierra; ROMANIA: Cero; USA: Cero; USSR: Zapadnoatlanticheskaya korolevskaya makrel, Zapadnoatlanticheskaya makrel; VENEZUELA: Carite chinigua.

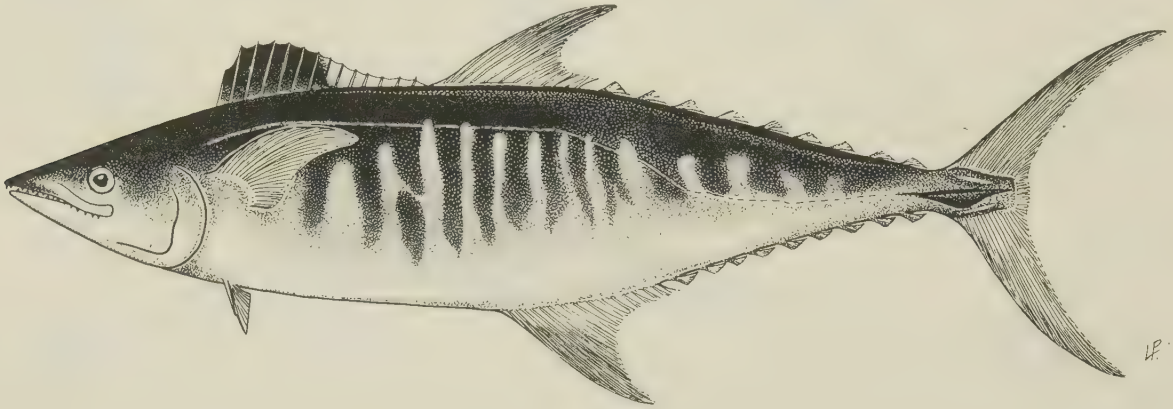
**Literature :** Collette (1978, Species Identification Sheets, Western Central Atlantic); Cooper (1982).

**Scomberomorus semifasciatus** (Macleay, 1884) | SCOMBR Scombm 17

Cybium semifasciatum Macleay, 1884, Proc.Linnean Soc.New South Wales, 8:205-206 (Burdekin River, Queensland).

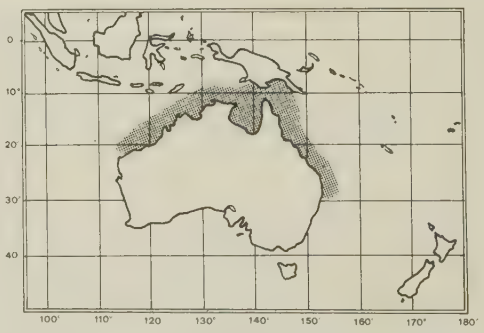
**Synonymy :** Cybium tigris De Vis, 1884; Scomberomorus semifasciatum - McCulloch & Whitley, 1925; Scomberomorus tigris - McCulloch & Whitley, 1925; Scomberomorus semifasciatus - McCulloch, 1929; Indocybium semifasciatum - Whitley, 1947.

**FAO Names :** En - Broadbarred king mackerel; Fr - Thazard tigre; Sp - Carite tigre.



**Diagnostic Features :** Gillrakers on first arch moderate: 1 or 2 on upper limb; 5 to 11 on lower limb, usually 7 to 9; 6 to 13 total, usually 11 or fewer. First dorsal fin with 13 to 15 spines; second dorsal with 19 to 22 rays, usually 20 or more, followed by 8 to 10 finlets, usually 9; anal fin with 19 to 22 rays, usually 21 or 22, followed by 7 to 10 finlets; many pectoral fin rays, 22 to 25, usually 23 or 24. Lateral line gradually curving down toward caudal peduncle. Vertebrae 18 or 19 precaudal plus 25 to 27 caudal, total 44 to 46, usually 45. Intestine with 2 folds and 3 limbs. Colour: juveniles (less than 10 cm) marked with 12 to 20 broad vertical dark grey bands; bars confined to region of body above lateral line, number increasing with age; cheeks and belly silver white; snout dark slate grey, patch of green above orbit; first dorsal fin jet black with contrasting areas of white in central region; second dorsal fin cream with yellow anteriorly; anal fin and finlets transparent white; caudal flukes creamy white at margins and dusky or blackish near hypural; pectoral fins dusky. With increase in size the bronze-green coloration of the back turns greenish blue. The vertical bands on the back are most marked in specimens less than 50 cm and in larger fish there is a tendency for these markings to become less distinct, break into spots or fade out more or less completely. Above 70 cm, dead fish assume a drab greyish-yellow blotchy appearance with little or no evidence of markings.

**Geographical Distribution :** Confined to southern Papua New Guinea and to northern Australia, from Shark Bay, western Australia to northern New South Wales (Collette & Russo, 1979: fig. 10).




**Habitat and Biology :** The biology of this epipelagic, neritic species is virtually unknown. Juveniles ranging between 4.5 and 10 cm in length are commonly encountered during November along the beaches in the vicinity of Townsville, Queensland and grow to twice this size by January (Munro, 1943).

**Size :** Maximum size is 120 cm fork length and a weight of 10 kg (Lewis, 1981), usually 1.3 to 2.7 kg.

**Interest to Fisheries :** Four species of Scomberomorus, including S. semifasciatus, and Grammatorcynus form Queensland's second most important fin-fishery with an annual production of about 1 000 tons of whole and filleted fish. Fish of 60 to 90 cm fork length are caught on fishing grounds north of Yeppoon, Queensland, in November, while smaller size groups are taken in estuaries north of Moreton Bay. Fishing gear includes set nets and lines. Popularly, anglers operating from small outboard powered boats troll with small lures or cut bait (Grant, 1982). Broadbarred king mackerels are also taken by trawlers in the Gulf of Papua.

**Local Names :** AUSTRALIA: Broad-barred mackerel, Broadbanded mackerel, Brownie; Queensland: Grey mackerel (for large individuals).

**Literature :** Munro (1943); Lewis (1981).

**Remarks :** Uniform grey colour of dead fish apparently accounts for the vernacular name "grey mackerel", Queensland fishermen use for adult fish. Report of S. semifasciatus from Thailand and Malaysia are based on misidentifications.

**Scomberomorus sierra** Jordan & Starks, 1895

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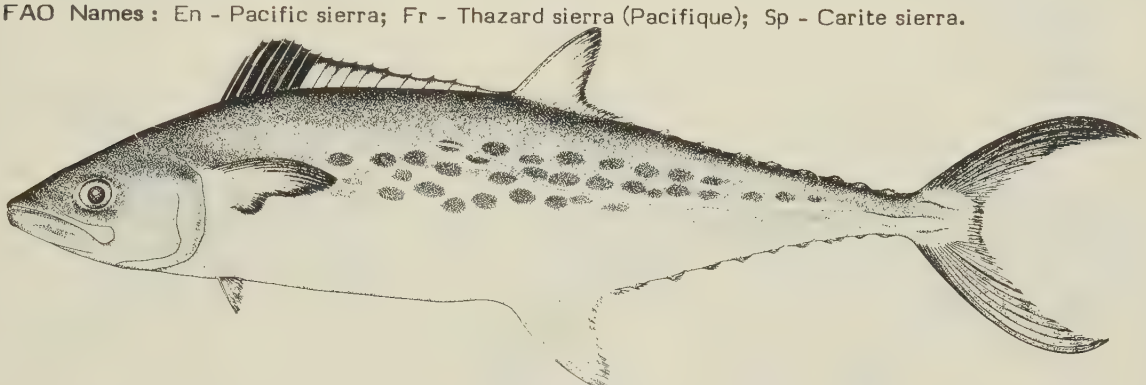
Scomberomorus sierra Jordan & Starks in Jordan, 1895, Proc.Calif.Acad.Sci., ser.2, 5:428-429 (Mazatlan, Mexico).

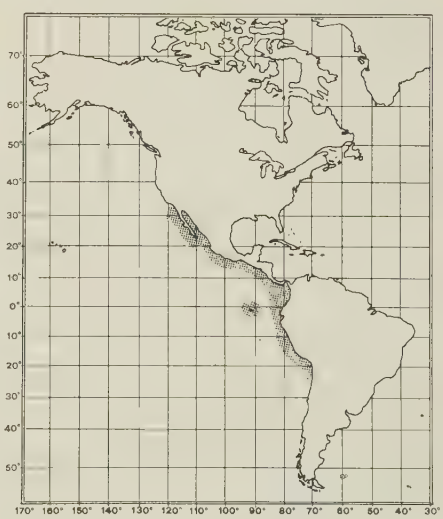
**Synonymy :** None.

**FAO Names :** En - Pacific sierra; Fr - Thazard sierra (Pacifique); Sp - Carite sierra.



**Diagnostic Features :** Gillrakers on first arch moderate: 2 to 4 on upper limb; 9 to 14 on lower limb, usually 12 or 13; 12 to 17 total, usually 14 to 16. First dorsal fin with 15 to 18 spines; second dorsal with 16 to 19 rays, followed by 7 to 10 finlets; anal fin with 16 to 21 rays, followed by 7 to 10 finlets; pectoral fin rays few, 20 to 24, modally 21; pelvic fins relatively long, 4.7 to 6.4% of fork length, compared to S. brasiliensis (3.6 to 5.9% of fork length). Lateral line gradually curving down toward caudal peduncle. Vertebrae 19 to 21 precaudal plus 26 to 29 caudal, total 46 to 49, usually 48. Intestine with 2 folds and 3 limbs. Colour: sides silvery with numerous round brownish (orange in life) spots, three rows below lateral line, one above; first dorsal fin black distally, white at base; second dorsal fin tinged with yellowish, margins black; anal fin white.

**Geographical Distribution :** Eastern tropical Pacific from La Jolla in southern California south to the Galapagos Islands and Paita, Peru (Collette & Russo, 1979:fig. 8). Recently reported from Antofagasta, Chile (Kong, 1978).



**Habitat and Biology :** A schooling, epipelagic, neritic species believed to spawn close to the coast over most of its range (Klawe, 1966). Off Mexico, the spawning season extends from July to September, in the Gulf of Nicoya, Costa Rica, from late August to the end of November, and in Colombia from November to April with a peak from February to April. Adults feed on small fishes, particularly anchovies (Anchoa and Cetengraulis) and clupeids (Odontognatus and Opisthonema).

**Size :** Maximum size is about 97 cm fork length and a weight of 5.4 kg or more, commonly to 60 cm. Fork length at first maturity ranges between 26 and 32 cm in Colombia (Artunduaga, 1972).

**Interest to Fisheries :** According to Walford (1937), S. sierra seems to be the most abundant game fish along the Pacific coasts of Mexico and Central America. It is an excellent food fish frequently taken by anglers and abundant enough to support a commercial fishery (Eckles, 1949). Statistics are reported for Fishing Areas 77 and 87, but the bulk of the catch is reported by Mexico, ranging between 3 644 metric tons in 1978 and 5 675 metric tons in 1981 (FAO, 1983). In Colombia, there is no commercial fishery directed at S. sierra, but it is taken by the shrimp fleet and by artisanal fishermen for a total catch of 127 tons in 1971 (Artunduaga, 1972).

**Local Names :** COLOMBIA: Sierra; COSTA RICA: Macarela, Sierra; ECUADOR: Sierra; MEXICO: Serrucho, Sierra; PANAMA: Sierra; PERU: Sierra, Verle; USA: Pacific sierra; USSR: Peruanskaya makrel.

**Literature :** Artunduaga (1972, gives also length-weight regression).

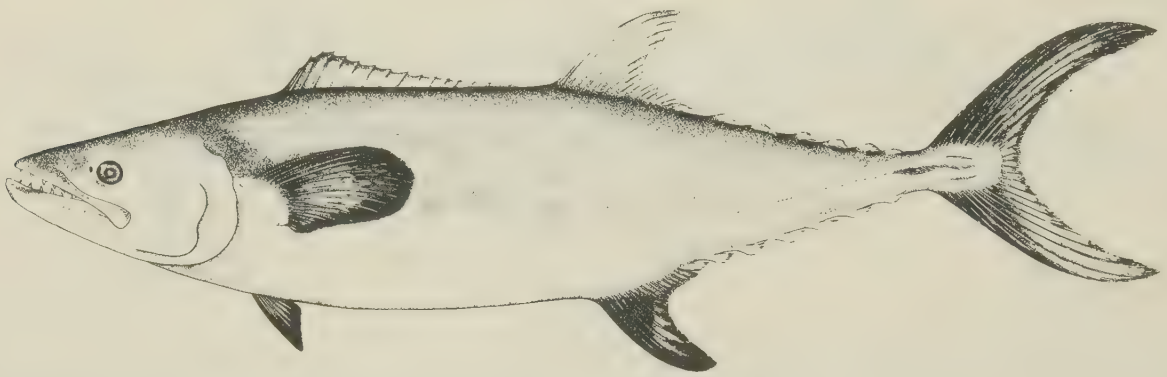
**Remarks :** Numerous authors have erroneously considered this species to be a synonym of S. maculatus, or a subspecies of it.

**Scomberomorus sinensis** (Lacepède, 1800) | SCOMBR Scombm 18

Scomber sinensis Lacepède, 1800, Histoire Naturelle des Poissons, 2:599 (based on Chinese drawing).

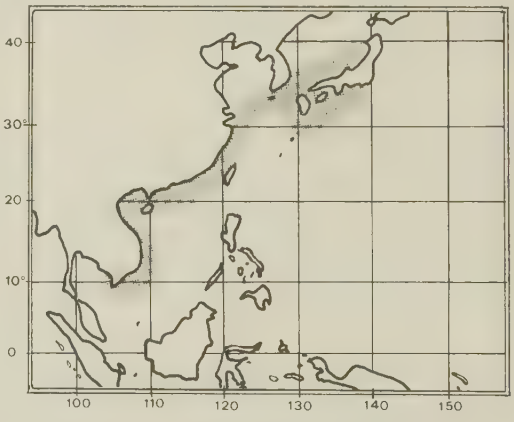
**Synonymy :** Cybium chinense Cuvier in Cuvier & Valenciennes, 1831; Scomberomorus sinensis - Jordan & Snyder, 1900; Scomberomorus chinensis - Jordan, Tanaka & Snyder, 1913; Cybium cambodgiense Durand, 1940; Scomberomorus chinense - Richards & Klawe, 1972; Scomberomorus cambodgiense - Orsi, 1974.

**FAO Names :** En - Chinese seerfish; Fr - Thazard nébuleux; Sp - Carite indochino.



**Diagnostic Features :** Gillrakers on first arch moderate: 1 to 3 on upper limb, usually 2; 9 to 12 on lower limb; 10 to 15 total. First dorsal fin with 15 to 17 spines; second dorsal with 15 to 17 rays, followed by only 6 or 7 finlets; anal fin with 16 to 19 rays, followed by only 5 to 7 finlets; pectoral fin rays 21 to 23. Lateral line abruptly curving down below first dorsal fin. Vertebrae few, 19 or 20 precaudal plus 21 or 22 caudal, total 41 or 42. Intestine with 2 folds and 3 limbs. Colour: sides silvery with large (larger than the diameter of the eye), round, indistinct spots in two poorly defined rows in adults; juveniles with saddlelike blotches extending down to about middle of body; fins mostly blackish; pelvic and anal fins with blackish margins, anal finlets colourless.

**Geographical Distribution :** Western Pacific from Akita, Honshu, Sea of Japan, Yellow Sea and China south to Viet Nam and Kampuchea where it enters the Mekong River.




**Habitat and Biology :** An epipelagic, neritic and estuarine species known to move 300 km up the Mekong River, above Phnom Penh but believed to reproduce only in marine waters. No information on the biology of Chinese seerfish was available to the authors.

**Size :** Maximum size is 200 cm fork length and 80 kg in weight.

**Interest to Fisheries :** No catches of S. sinensis were reported to FAO for the period between 1978 and 1981. However, it is a prized food fish in Japan and probably in China as well. It is caught in the Mekong River of Kampuchea and commanded a high price in the Phnom Penh market in 1964 (Aubenton & Blanc, 1965:242).

**Local Names :** JAPAN: Ushisawara; USSR: Kitajskaya makrel, Krupnopyatnistaya makrel; VIET NAM: Cá thu trung-hoa.

**Literature :** Kishinouye (1923); Aubenton & Blanc (1965, give also a length-weight graph).

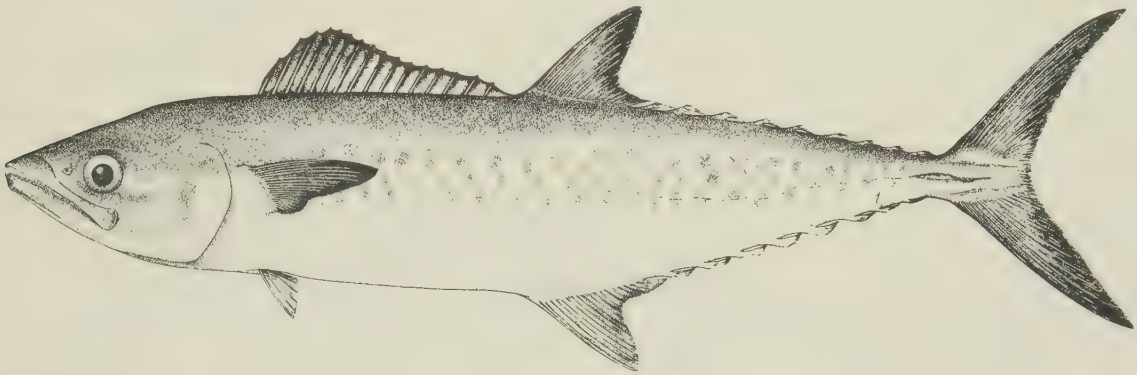
**Scomberomorus tritor** (Cuvier, 1831)

SCOMBR Scombm 7

Cybium tritor Cuvier in Cuvier & Valenciennes, 1831, Histoire Naturelle des Poissons, 8:176-177, pl. 218 (Gorée, Senegal).

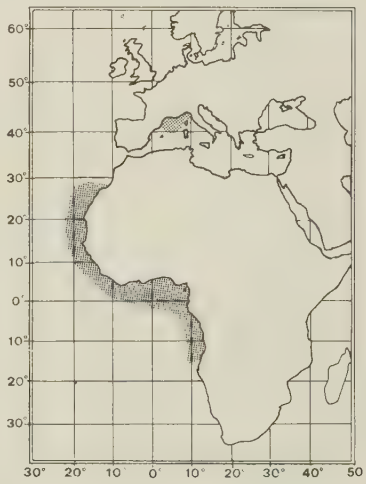
**Synonymy :** Apolectus immunis Bennett, 1831; Scomberomorus argyreus Fowler, 1905; Scomberomorus tritor - Munro, 1943.

**FAO Names :** En - West African Spanish mackerel; Fr - Thazard blanc; Sp - Carite lusitánico.



**Diagnostic Features :** Gillrakers on first arch moderate: 1 to 3 on upper limb, usually 2; 10 to 13 on lower limb; 12 to 15 total. First dorsal fin with 15 to 18 spines, usually 16 or more; second dorsal with 16 to 19 rays, usually 17, followed by only 7 to 9 finlets; anal fin with 17 to 20 rays, followed by 7 to 9 finlets; pectoral fin rays 20 to 22. Lateral line gradually curving down toward caudal peduncle. Vertebrae 18 or 19 precaudal plus 27 or 28 caudal, total 46 or 47, usually 19 plus 27, total 46. Intestine with 2 folds and 3 limbs. Colour: sides silvery with about three rows of vertically elongated spots, some large individuals with thin vertical bars; anterior half of first dorsal fin and margin of posterior half of first fin black, base of posterior half white.

**Geographical Distribution :** Eastern Atlantic, concentrated in the Gulf of Guinea from the Canary Islands and Dakar south to Baia dos Tigres, southern Angola. Also found, rarely, in the northern Mediterranean Sea, along the coasts of France and Italy (Collette & Russo, 1979:fig. 8).




**Habitat and Biology :** An epipelagic, neritic species penetrating into coastal lagoons. The spawning season is believed to extend from April to October in Senegal. Approximately 1 million eggs were estimated in a 95 cm long female (Postel, 1955). In Lagos lagoon the species feeds on clupeids, particularly Ethmalosa fimbriata (Fagade & Olaniyan, 1973).

**Size :** Maximum fork length is at least 98 cm in females, and 84 cm in males; commonly ranging between 50 and 70 cm. Fork length at first maturity is 45 cm for both sexes (Postel, 1955).

**Interest to Fisheries :** The species is taken throughout the Gulf of Guinea but catches are reported only by Ghana (accounting for almost the entire catch: about 700 metric tons per year up to 1978) and Angola. In recent years world catches increased considerably, reaching 4 412 metric tons in 1980, but collapsing to 2 051 metric tons in 1981 (FAO, 1983).

**Local Names :** FRANCE: Maquereau bonite; SENEGAL: Dioun (Lebou), Maquereau-bonite, Ndiounde (Ouoloff), Tazart; USSR: Ehapadnoafrikanskaya makrel.

**Literature :** Postel (1955); Collette (1981, Species Identification Sheets, Eastern Central Atlantic).

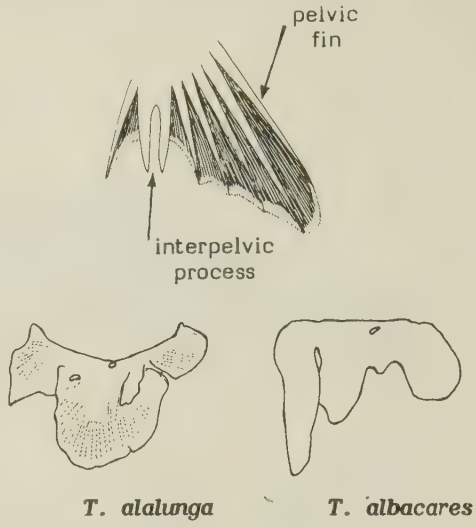
**Remarks :** This species has erroneously been considered as a synonym of the western Atlantic S. maculatus by many authors.

**Thunnus** South, 1845

SCOMBR Thun

**Genus with reference :** Thunnus South, 1845:620. A substitute name for Thynnus Cuvier, 1817, preoccupied, and taking the same type-species: Scomber thynnus Linnaeus, 1758, by absolute tantonomy.

**Diagnostic Features :** Body fusiform, elongate, and slightly compressed. Teeth small and conical, in a single series; gillrakers 19 to 43 on first arch. Two dorsal fins, separated only by a narrow interspace, the first with 11 to 14 spines, anterior spines much higher than posterior spines giving the fin a strongly concave outline; second dorsal fin with 12 to 16 rays, shorter, as high as, or higher than first dorsal fin; followed by 7 to 10 dorsal finlets; anal fin with 11 to 16 rays, about as high as second dorsal fin, followed by 7 to 10 finlets; pectoral fin of variable length depending on species and age, with 30 to 36 rays, more than in any other genus of Scombridae; interpelvic process small and bifid. Body with very small scales; corselet of larger scales developed but not very distinct. Caudal peduncle very slender, bearing on each side a strong lateral keel between 2 smaller keels. Swimbladder present in most species. Vertebrae 39. Liver in ventral view either without striations and the right lobe largest (T. albacares, T. atlanticus, T. tonggol) or with prominent striations and the central lobe largest (T. alalunga, T. maccoyii, T. obesus, T. thynnus). Colour: back metallic dark blue, lower sides and belly whitish; no dark stripes or spots on sides; finlets bright yellow, edged with black in several species.




*T. alalunga* *T. albacares*

**Habitat and Biology :** Tunas are mostly oceanic species with epipelagic to mid-water (>500 m depth) distributions depending on species and size. They do not inhabit the polar seas. They are unique among bony fish for their high metabolic rate (resulting in an extraordinary growth pattern) and in their vascular heat exchanger system (retia mirabile) permitting them to maintain body temperatures several degrees higher than the ambient water. As muscles are more powerful when warm, this guarantees steady swimming required to maintain sufficient gas exchange via the gills, which in turn is indispensable to sustain their high metabolism. As juveniles they must swim upwards of 50 km per day and are capable of remarkable bursts of speed (Magnuson, 1978). The ability to regulate body temperature increases with size and is of particular importance to albacore, yellowfin tuna, bigeye tuna, and is best developed in bluefin tuna.

Tunas are agile, opportunistic predators feeding on a great variety of suitably sized forage fishes, crustaceans and squids. Because of their size, adult tunas have few predators, mainly billfishes, sharks, and toothed whales.

**Interest to Fisheries :** The world catch of Thunnus species remained relatively stable around 750 000 metric tons in the period between 1975 and 1981, but exceeded 1 million metric tons in 1978 (FAO, 1983). Japan (more than 300 000 metric tons in 1981), the USA and the Republic of Korea (about 100 000 metric tons each in 1981) alone accounted for more than 60% of the world catch (FAO, 1983). Apart from being taken by big game sportsfishermen on hook and line and trolling lines, tunas are caught predominantly by industrial gear including purse seines, live bait hook-and-line, conventional longlines and deep longlines. Presently, the tuna fishing industry faces at least two major problems apart from market fluctuations:

- rising fuel costs that have already forced adoption of less energy-intensive fishing methods i.e. by reducing searching time through introduction of a variety of fish-locating and aggregating aides;
- insufficient supply of suitable bait fishes for potential surface fisheries which has induced aquaculturists to investigate the feasibility of economic mass rearing of convenient species. There have been several trials to test the utility of cultured bait, since the behaviour, growth, hardiness and shape of bait have a great bearing on its efficient use in the tuna fisheries. However, the bait fish rearing operations do not appear to be viable in any industrial context, particularly in island areas where land and labour are at a premium.

Another aspect deserving attention is the by-catch of the tuna longline fisheries, which is particularly composed of various sharks, but includes dolphin and other finfishes (Sivasubramanian, 1963). This is mostly discussed in terms of the damage inflicted to the tuna catch and not so much as an additional source of food. In the southeastern Arabian Sea and the Laccadive Sea, sharks constituted 63.8% by number and 57.8% by weight of the total catch during March to May 1981 (Silas & Pillai, 1982). Part of the by-catch is discarded, but another part is locally marketed. There is also a substantial rejection rate of tunas caught in most longline fisheries because they may be too small to sell at reasonable prices in the major high-quality, size-specific market places. Reported landings are believed to be underestimating catches by as much as 25% in numbers in some fisheries.

In general, however, all species are highly appreciated and marketed fresh, deep frozen or canned.

**Literature:** Gibbs & Collette (1967); Sharp & Dizon (1978).

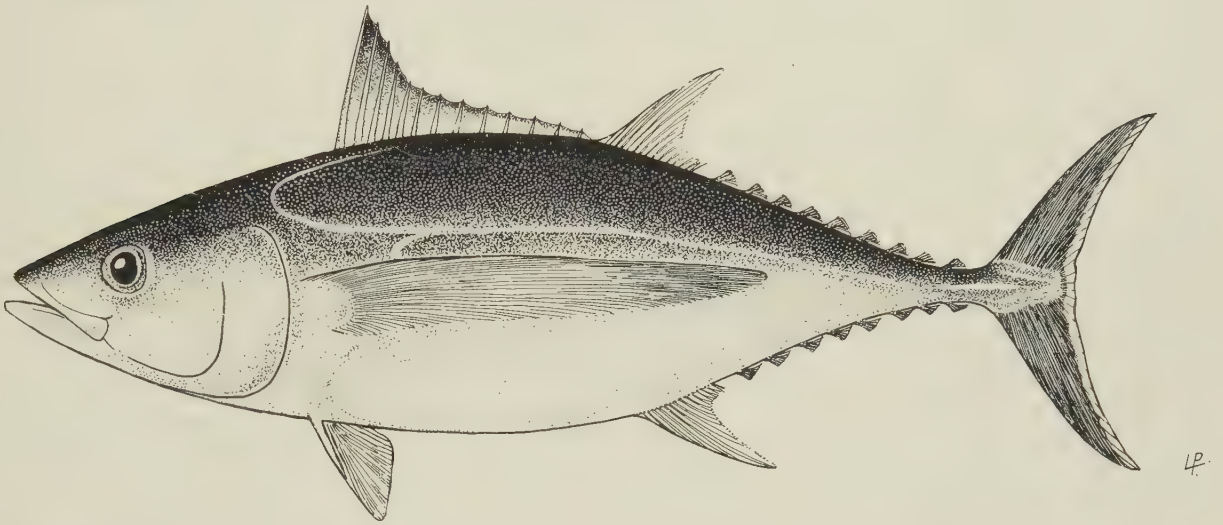
**Thunnus alalunga** (Bonnaterre, 1788)

SCOMBR Thun 1

Scomber alalunga Bonnaterre, 1788, Tableau Encyclopédique et Méthodique, Ichthyologie:139 (Sardinia)

**Synonymy :** Scomber alatunga - Gmelin, 1789; Scomber germo Lacepède, 1800; Orcynus germon - Cuvier, 1817; Orcynus alalonga - Risso, 1826; Thynnus alalonga - Cuvier in Cuvier & Valenciennes, 1831; Thynnus pacificus Cuvier in Cuvier & Valenciennes, 1831; Orcynus alatunga - Gill, 1862; Thunnus alalonga - South, 1845; Thunnus pacificus - South, 1845; Orcynus pacificus Cooper, 1863; Orcynus germo - Lütken, 1880; Germo alalonga - Jordan, 1888; Albacora alalonga - Dresslar & Fesler, 1889; Germo alalunga - Jordan & Evermann, 1896; Thynnus alalunga - Clarke, 1900; Germo germon - Fowler, 1905; Germo germo - Jordan & Seale, 1906; Thunnus alalunga - Jordan, Tanaka, & Snyder, 1913; Thunnus germo - Kishinouye, 1923; Germo germon steadi Whitley, 1933.

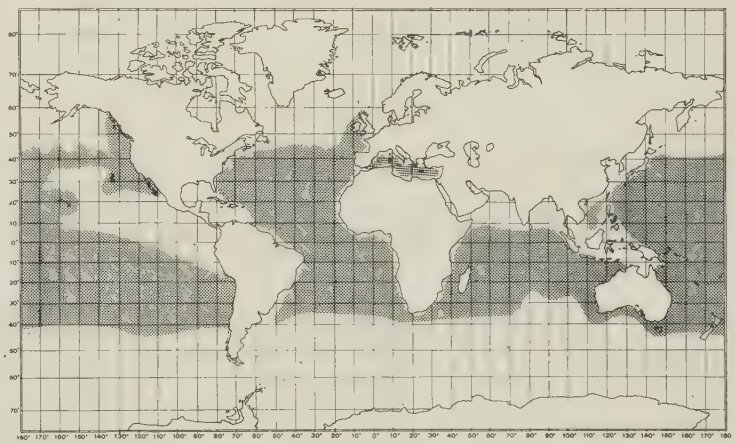
**FAO Names :** En - Albacore; Fr - Germon; Sp - Atún blanco.



**Diagnostic Features :** A large species, deepest at a more posterior point than in other tunas (at, or only slightly anterior to, second dorsal fin rather than near middle of first dorsal fin base). Gillrakers 25 to 31 on first arch. Second dorsal fin clearly lower than first dorsal; pectoral fins remarkably long, usually 30% of fork length or longer in 50 cm or longer fish, reaching well beyond origin of second dorsal fin (usually up to second dorsal finlet). Fish smaller than 50 cm will have proportionately smaller pectorals than other tunas, i.e. T. obesus. Ventral surface of liver striated (vascular network). Swimbladder present, but poorly developed and not evident in fish smaller than about 50 cm fork length. Vertebrae 18 precaudal plus 21 caudal. Colour: a faint lateral iridescent blue band runs along sides in live fish; first dorsal fin deep yellow, second dorsal and anal fins light yellow, anal finlets dark; posterior margin of caudal fin white.

liver

**Geographical Distribution :** Cosmopolitan in tropical and temperate waters of all oceans including the Mediterranean Sea, extending north to 45 to 50°N and south to 30 to 40°S, but not at the surface between 10°N and 10°S.



**Habitat and Biology :** An epi- and mesopelagic, oceanic species, abundant in surface waters of 15.6° to 19.4°C; deeper swimming, large albacore are found in waters of 13.5° to 25.2°C; temperatures as low as 9.5°C may be tolerated for short periods. In the Atlantic, the larger size classes (80 to 125 cm) are associated with cooler water bodies, while smaller individuals tend to occur in warmer strata. According to data presently available, the opposite occurs in the northeastern Pacific. Albacore tend to concentrate along thermal discontinuities (oceanic fronts such as the Transition Zone in the north Pacific and the Kuroshio Front east of Japan) where large catches are made. The Transition Zones are preferred to cooler upwelling waters which are richer in forage organisms but poorer in oxygen content. Minimun oxygen requirements are probably similar to those of yellowfin tuna, that is about 2 ml/l. Albacore migrate within water masses rather than across temperature and oxygen boundaries.

Throughout its range, the albacore migrates over great distances and appears to form separate groups at different stages of its life cycle. Several diverging, sometimes contradictory models have been suggested to portray these migrations. At least two stocks (northern and southern) are believed to exist in both the Atlantic and the Pacific Oceans, each with distinct spawning areas and seasons and with little or no interchange across the warm equatorial waters.

The depth distribution in the Pacific ranges from the surface down to at least 380 m and is governed by the vertical thermal structures and oxygen contents of the water masses. In the Atlantic, for the same environmental determinants, albacore are believed to occur as deep as 600 m. Like other tunas, albacore form schools with fewer fish, hence more compact units when composed of larger fish. They may also form mixed schools with skipjack tuna, yellowfin tuna and bluefin tuna. Schools may be associated with floating objects, including sargassum weeds.

Although fecundity does increase with size generally, there is no close relationship between fork length and ovary-weight and hence, number of eggs; a 20 kg female may produce between 2 and 3 million eggs per season, which are released at least in two batches. The sex ratio in catches is about 1:1 for immature specimens, but males predominate among mature fishes, which is possibly due to both differential mortality of sexes, and differential growth rate after maturity.

**Size :** Maximum fork length is 127 cm. The all-tackle angling record is a 40 kg fish with a fork length of 123 cm taken in the Canary Islands in 1977. In the Pacific surface fishery (pole-and-line, and troll fishery), smaller sizes (modes between 55 to 80 cm fork length) predominate, while longline fisheries take bigger fish (modes about 95 to 115 cm); in the Indian Ocean, common sizes range from 40 to 100 cm fork length (Silas & Pillai, 1982), while males up to 109 cm and females up to 106 cm are not exceptional in the Atlantic. In the Pacific, maturity may be attained at about 90 cm fork length in females and at about 97 cm in males; in the Atlantic it is reached at about 94 cm in both sexes.

**Interest to Fisheries :** There are important fisheries for T. alalunga in the Atlantic and Pacific Oceans. Catches have been reported from 15 FAO Fishing Areas by 15 countries in the period from 1974 to 1981. Along with increasing effort in the major fisheries, the world catch has been gradually declining from a peak of about 245 000 metric tons in 1974 to a low of about 181 000 metric tons in 1981 (FAO, 1981, 1983). More than half of the catch in the last years was taken in the Pacific, particularly in Fishing Areas 61, 77 and 81. The landings in Area 61 were almost exclusively made by Japanese vessels. More than 10 000 metric tons were reported in 1981 from two other fishing areas, namely Areas 27 (predominantly by Spain, while the French catch collapsed to less than one tenth of its previous level) and 47 (FAO, 1983).

Albacore fisheries involve 4 basic types of fishing operations: longlining, live-bait fishing, trolling, and purse seining. Surface methods (trolling, purse-seining, live-bait) tend to take smaller fish than longlining. In recent years, boats and gear have been improved by introduction of longer vessels (trollers up to 22 m length), more modern boatbuilding materials (fiberglass, aluminium, etc.), larger ice storage or brine freezing capacities, better navigational aids and fish locating devices, and larger bait-holding capacities that increase the autonomy of the vessels.

The most important albacore fisheries are the following:

In the Pacific there are 5 major fisheries which are operational at various times of the year:

- The Japanese live-bait fishery originates south of Japan and then develops offshore into the area of the Kuroshio Front. It extends from March through July, with a peak in June.

- The Japanese longline fishery operates across the North Pacific throughout the year, although the best catches are obtained from December to February.

- The US surface fishery from off Baja California to Canada attains its peak in August and September; fishing activities extend from June to December in the northern part of this area and from May to January in the southern part; 90% of catches are taken in waters of 15.6° to 19.4°C; catches of this fishery are believed to include fishes as young as one year of age, with only few mature adults.

- Longline operations in the South Pacific between 10° and 40°S from Samoan and Japanese bases extend throughout the year with the peak season from August to February.

- The New Zealand surface fishery, mostly in waters from 18.5° to 21.3°C, extends from January to April, with best catches usually in February.

Albacore is also caught as a by-catch in the Hawaiian longline fishery for yellowfin and bigeye tuna.

In the Indian Ocean, the fishery is barely developed, but areas of potentially successful exploitation, as derived from an assessment of favourable hydrographical conditions, are given in Sharp (1979). Up to the mid-sixties, catches in this area were taken exclusively by Japanese vessels, while in the late seventies, vessels from Taiwan, Province of China, were the most abundant, followed by boats from the Republic of Korea and Japan.

In the Atlantic, there are at least 3 fisheries for albacore:

- A trolling fishery dating back to the last century which has undergone mechanization of boats and gear and introduced on-board processing of fish. It is operated primarily by Spanish and French vessels in the Bay of Biscay and the West European Basin.

- A more recent pole-and-line fishery initiated after World War II by French and Spanish bait-boats in the Bay of Biscay and off northern Portugal; this activity is restricted to the summer months. A recent offshoot of this fishery, dating from 1970, is the seasonal pole-and-line activity in fall off Morocco by Azores- and Maideira-based Spanish and Portuguese vessels.

- Seasonal summer and winter longline fisheries operating in different offshore areas in the northern and southern hemispheres. These fisheries were operated almost exclusively by long-distance fleets from Japan up to 1970, but since that time vessels from the Republic of Korea and Taiwan Island are also participating. On a smaller scale, countries like Brazil, Cuba and Venezuela have entered this fishery.

**Local Names :** ANGOLA: Avoador; ARGENTINA: Albacora; BRAZIL: Albacora branca; CANADA: Albacore, Germon atlantique; CHILE: Atún de aleta larga; COLOMBIA: Albacora; CUBA: Albacora; DOMINICAN REPUBLIC: Albacora; ECUADOR: Atún; EGYPT: Tunna; FRANCE: Germon; GERMANY FR: Weisser Thun; GREECE: Tonnos macropteros; ISRAEL: Garmon; ITALY: Alalonga; JAPAN: Binnaga, Tonbo; KENYA: Jodari (Swahili); KOREA REP: Nal-gae-da-raeng-i; MALTA: Ala-longa; MARTINIQUE: Germon; MEXICO: Albacora; MONACO: Ara-lunga; MOROCCO: Germon, Thone; NEW ZEALAND: Albacore tuna; PACIFIC ISLANDS TRUST TERRITORIES: Aáhi taria; PANAMA: Albacora; PERU: Albacora, Alalunga, Atún de aleta larga; POLAND: Germon; PORTUGAL: Albacora, Voador; PUERTO RICO: Albacora ROMANIA: Ton cu inotatoare lungi; SENEGAL: Bonette; SOMALIA: Jodari (Swahili); SOUTH AFRICA: Albacore, Albakoor, Langvin tuna, Longfin tunny; SPAIN: Albacora, Atún blanco; SWEDEN: Albakore; TAIWAN, PROVINCE OF CHINA: Chang chi we; TANZANIA: Jodari (Swahili); TUNISIA: Ghzel; TURKEY: Yazili orkinos; UK: Albacore; URUGUAY: Albacora; USA: Albacore; Hawaii: Ahipahala; USSR: Albakor, Belokrylyj tunets, Belyj tunets, Dlinnoperyj tunets; VENEZULEA: Albacora; VIET NAM: Cá ngir vây dài; YUGOSLAVIA: Silac.

**Literature :** Postel (1963b); Yoshida & Otsu (1963); Fischer, ed. (1973, Species Identification Sheets, Mediterranean and Black Sea); Fischer & Whitehead, eds (1974, Species Identification Sheets, Eastern Indian Ocean/Western Central Pacific); Le Gall (1974); Collette (1978, Species Identification Sheets, Western Central Atlantic; 1981, Species Identification Sheets, Eastern Central Atlantic); Dotson (1980, describes methods and gear for northeast Pacific fleets); Foreman (1980, summarizes i.e. growth parameter estimates); Bard (1981, Ph.D.thesis); Le Gall (1981, bibliography).

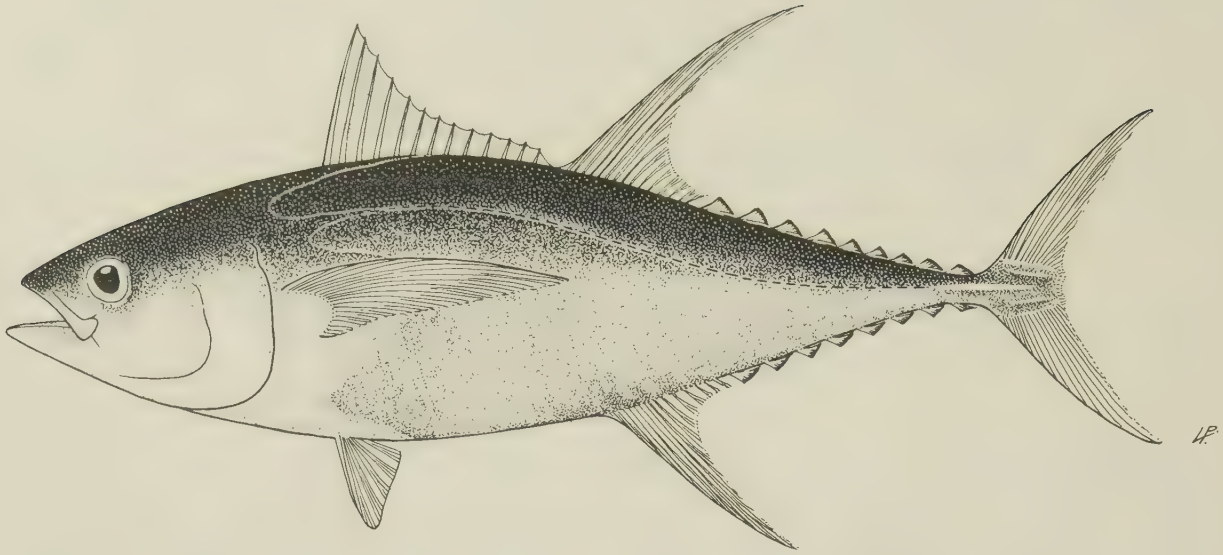
**Remarks :** Note that the vernacular name "albacora" is used for swordfish (Xiphias gladius) in Chile, while it is commonly used for T. alalunga in other Spanish speaking countries, while in the eastern Atlantic "albacore" is used by francophones for the yellowfin tuna (T. albacares).

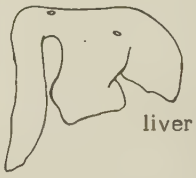
**Thunnus albacares** (Bonnaterre, 1788) | SCOMBR Thun 3

Scomber albacares Bonnaterre, 1788, Tableau Encyclopédique et Méthodique, Ichthyologie:140 (Jamaica).

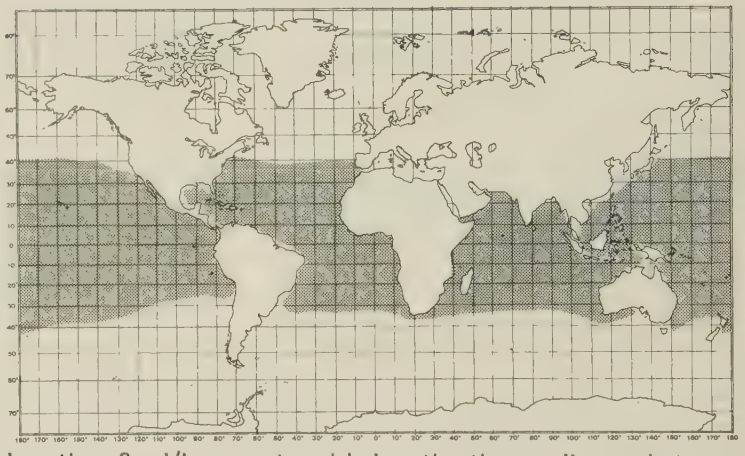
**Synonymy :** Scomber albacorus Lacepède, 1800; Thynnus argentivittatus Cuvier in Cuvier & Valenciennes, 1831; Scomber sloanei Cuvier in Cuvier & Valenciennes, 1831;. Thynnus albacora Lowe, 1839; Thynnus macropterus Temminck & Schlegel, 1844; Thunnus argentivittatus - South, 1845; Orcynus subulatus Poey, 1875; Orcynus albacora - Poey, 1875; Orcynus macropterus - Kitahara, 1897; Germo macropterus - Jordan & Snyder, 1901; Thunnus macropterus - Jordan, Tanaka & Snyder, 1913; Thunnus allisoni Mowbray, 1920; Germo argentivittatus - Nichols & Murphy, 1922; Germo allisoni - Nichols, 1923; Neothunnus macropterus - Kishinouye, 1923; Neothunnus catalinae Jordan & Evermann, 1926; Neothunnus albacora - Jordan & Evermann, 1926; Neothunnus itosibi Jordan & Evermann, 1926; Neothunnus albacores - Jordan & Evermann, 1926; Neothunnus allisoni - Jordan & Evermann, 1926; Kishinoella zacalles Jordan & Evermann, 1926; Semathunnus guildi Fowler, 1933; Semathunnus itosibi - Fowler, 1933; Neothunnus argentivittatus - Beebe & Tee-Van, 1936; Germo albacora - Fowler, 1936; Thunnus albacora - Tortonese, 1939; Germo itosibi - Smith, 1949; Neothunnus albacora brevipinna Bellón & Bardán de Bellón, 1949; Neothunnus albacora longipinna Bellón & Bardán de Bellón, 1949; Neothunnus macropterus macropterus - Bellón & Bardán de Bellón, 1949; Neothunnus macropterus itosibi - Bellón & Bardán de Bellón, 1949; Neothunnus brevipinna - Postel, 1950; Thunnus zacalles - Fraser-Brunner, 1950; Thunnus albacares - Ginsburg, 1953; Thunnus catalinae - Ginsburg, 1953; Neothunnus albacares - Mather, 1954; Thunnus albacores - Le Danois, 1954; Neothunnus albacora macropterus - Schultz, 1960; Thunnus albacares macropterus - Jones & Silas, 1963a; Thunnus itosibi - Jones & Silas, 1963a.

**FAO Names :** En - Yellowfin tuna; Fr - Albacore; Sp - Rabil.






**Diagnostic Features :** A large species, deepest near middle of first dorsal fin base. Gillrakers 26 to 34 on first arch. Some large specimens have very long second dorsal and anal fins, which can become well over 20% of fork length; pectoral fins moderately long, usually reaching beyond second dorsal fin origin but not beyond end of its base, usually 22 to 31% of fork length. No striations on ventral surface of liver. Swimbladder present. Vertebrae 18 precaudal plus 21 caudal. Colour: back metallic dark blue changing through yellow to silver on belly; belly frequently crossed by about 20 broken, nearly vertical lines; dorsal and anal fins, and dorsal and anal finlets, bright yellow, the finlets with a narrow black border.



**Geographical Distribution :** Worldwide in tropical and subtropical seas, but absent from the Mediterranean Sea.

**Habitat and Biology :** Epipelagic, oceanic, above and below the thermocline. The thermal boundaries of occurrence are roughly $18^{o}$ and $31^{o}$C. Vertical distribution appears to be influenced by the thermal structure of the water column, as is shown by the close correlation between the vulnerability of the fish to purse seine capture, the depth of the mixed layer, and the strength of the temperature gradient within the thermocline. Yellowfin tuna are essentially confined to the upper 100 m of the water column in areas with marked oxyclines, since oxygen concentrations less than 2 ml/l encountered below the thermocline and strong thermocline gradients tend to exclude their presence in waters below the discontinuity layer. Larval distribution in equatorial waters is transoceanic the year round, but there are seasonal changes in larval density in subtropical waters. It is believed that the larvae occur exclusively in the warm water sphere, that is, above the thermocline.

Schooling occurs more commonly in near-surface waters, primarily by size, either in monospecific or multispecies groups. In some areas, i.e. eastern Pacific, larger fish (greater than 85 cm fork length) frequently school with porpoises. Association with floating debris and other objects is also observed.

Although the distribution of yellowfin tuna in the Pacific is nearly continuous, lack of evidence for long-ranging east-west or north-south migrations of adults suggests that there may not be much exchange between the yellowfin tuna from the eastern and the central Pacific, nor between those from the western and the central Pacific. This hints at the existence of subpopulations.

Spawning occurs throughout the year in the core areas of distribution, but peaks are always observed in the northern and southern summer months respectively. Joseph (1968) gives a relationship between size and fecundity of yellowfin tuna in the eastern Pacific.

**Size :** Maximum fork length is over 200 cm. The all-tackle angling record was a 176.4 kg fish of 208 cm fork length taken off the west coast of Mexico in 1977. Common to 150 cm fork length.

Off the Philippines and Central America, the smallest mature fish were found within the size group from 50 to 60 cm fork length at an age of roughly 12 to 15 months (Davidoff, 1963), but between 70 and 100 cm fork length the percentage of mature individuals is much higher. All fish over 120 cm attain sexual maturity.

**Interest to Fisheries :** There are important yellowfin tuna fisheries throughout tropical and subtropical seas. Recent catch statistics for this species include reports from 14 fishing areas by 35 countries. The most important catches (well over 100 000 metric tons) are recorded from Fishing Areas 71, 77 and 34 (slightly less than 10 000 metric tons). Japan and the USA were the two countries with the largest catch (about 100 000 metric tons each per year). Landings were relatively stable over the period from 1975 to 1981, varying only between about 496 000 and 545 000 metric tons. The world catch for 1981 totalled 526 340 metric tons (FAO, 1983). The above level of production could be maintained due to an increase in fishing effort, but reduction in catches per unit effort suggests decreasing abundance of some stocks.

Near-surface schooling yellowfin tuna are captured primarily with purse seines and by pole-and-line fishing, while trolling and gillnetting are of much lesser importance. The 1979 eastern Pacific surface fleet numbered 259 purse seiners, 45 bait boats, and 17 other vessels flying 16 flags. The carrying capacity of this fleet amounted to 169 149 metric tons. Purse seining is increasing in the western Pacific, initially taking mainly skipjack and bluefin tuna. In 1982, the yellowfin tuna catch by US purse seiners in this area probably exceeded that of skipjack tuna, and the total purse seine catch of yellowfin by all vessels may have been higher than that of bluefin tuna.

Pole-and-line fishing is still one of the major surface fishing techniques for yellowfin tuna in the Pacific, even though this method is declining in overall importance throughout the world.

The most important fishing method for deep swimming yellowfin tuna is longlining, primarily by vessels from Japan, the Republic of Korea and Taiwan Island. Although these fisheries operate virtually throughout the geographical range of the species, the largest catches are made in the equatorial waters of the Pacific.

For the purpose of assessing maximum sustainable yield of yellowfin stocks, the Inter-American Tropical Tuna Commission has established a Yellowfin Regulatory Area (CYRA) and some experimental fishing areas in the eastern Pacific. The fishery has been under regulation since 1966. However, since 1979, the I-ATTC has been unable to administer effectively any conservation measures due to lack of agreement on a quota system in the CYRA among its member countries. Overfishing was suspected a couple of years ago, but the 1982 catch was so low that this is no longer the case.

In the Indian Ocean, yellowfin tuna were taken exclusively by Japanese vessels up to the early sixties, but thereafter, boats from the Republic of Korea and Taiwan, Province of China, started operating in this area and acounted for more than 50% of the total catch by the late seventies. Nevertheless, Indian Ocean yellowfin tuna fisheries are not yet fully developed. Based on hydrographical data, Sharp (1979) has suggested the existence of certain areas of potential exploitation.

**Local Names :** ARGENTINA: Aleta amarilla; AUSTRALIA: Yellowfinned albacore; BRAZIL: Albacora de lage; CUBA: Atún de aleta amarilla; FRANCE: Thon à nageoires jaunes; GERMANY FR: Gelbflossenthun; GREECE: Tonnos macropteros; INDIA: Howalla, Kelawalla (Sinhalese); ITALY: Tonno albacora; JAPAN: Hatsu, Kihada, Kimeji (young), Kiwada; MALTA: Tonn; MARTINIQUE: Albacore, Z'aile jaune; NETHERLANDS: Geelvintonijn; NORWAY: Albakor; PACIFIC ISLANDS TRUST TERRITORIES: Palau: Tkuu; PHILIPPINES: Albacora, Badla-an, Buyo, Tambakol; POLAND: Albakora; PORTUGAL: Atum albacora, Atum rabil, Peixinho da ilho; ROMANIA: Albacora, Ton galben; SENEGAL: Albacore; Doullou-doullou (Ouoloff); Thon à nageoires jaunes; Wakhandor (Lebou); SOUTH AFRICA: Geelvin-tuna, Yellowfin tuna; SPAIN: Rabil; SWEDEN: Albacora; UK: Yellowfin tuna; URUGUAY: Aleta amarilla; USA: Yellowfin tuna; Hawaii: 'Ahi, Kahauli, Kanana, Maha'o, Palaha; USSR: Albacor, Tikhookeanskij zheltoperyj tunets, Zheltoperyj tunets, Zheltokhvostyj tunets; VENEZUELA: Atún aleta amarilla; VIET NAM: Cá bò Vang; YUGOSLAVIA: Tuna zutoperka.

**Literature :** Mimura et al. (1963, Indian Ocean); Schaefer, Broadhead & Orange (1963, Pacific); Vilela & Frade (1963, eastern Atlantic); Fischer & Whitehead, eds (1974, Species Identification Sheets, Eastern Indian Ocean/Western Central Pacific); Collette (1978, Species Identification Sheets, Western Central Atlantic; 1981, Species Identification Sheets, Eastern Central Atlantic); Sharp (1978, describes the relation between vulnerability to surface gear, schooling, and environmental processes); Cole (1980, Pacific, summarizes i.e. growth parameter estimates).

**Thunnus atlanticus** (Lesson, 1830)

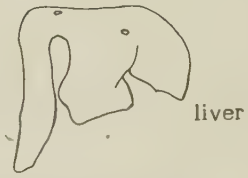
SCOMBR Thun 7

Thynnus atlanticus Lesson, 1830, Voyage sur la corvette "La Coquille", Zoologie, 10:165-166 (Trinidade Island off Brazil).

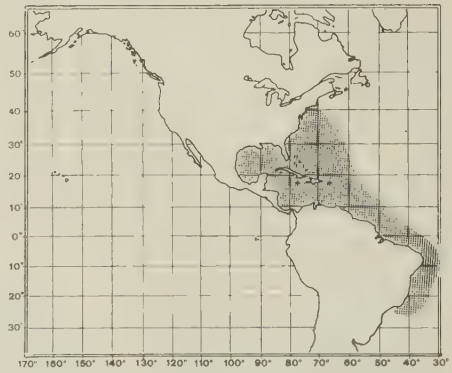
**Synonymy :** Thynnus coretta Cuvier in Cuvier & Valenciennes, 1831; Thynnus balteatus Cuvier in Cuvier & Valenciennes, 1831; Thunnus balteatus - South, 1845; Thunnus coretta - South, 1845; Orcynus balteatus - Poey, 1868; Parathunnus rosengarteni Fowler, 1934; Parathunnus ambiguus Mowbray, 1935; Parathunnus altanticus - Beebe & Hollister, 1935; Thunnus atlanticus - Rivas, 1951.

**FAO Names :** En - Blackfin tuna; Fr - Thon à nageoires noires; Sp - Atún aleta negra.

**Diagnostic Features :** A small species of tuna, deepest near middle of first dorsal fin base. Gillrakers few, 19 to 25 on first arch. Pectoral fins moderate in length, usually 22 to 31% of fork length. Ventral surface of liver not striated, right lobe longer than centre and left lobes. Small swimbladder present. Vertebrae 19 precaudal plus 20 caudal. Colour: back metallic dark blue, lower sides uniformly silvery grey or with pale streaks and spots at least partly in vertical rows, belly milky white; first dorsal fin dusky, second dorsal and anal fins dusky with a silvery lustre; finlets dusky with a trace of yellow.




**Geographical Distribution :** Restricted to the western Atlantic Ocean, from off Martha's Vineyard, Massachusetts south to Trinidade Island and Rio de Janeiro, Brazil.



**Habitat and Biology :** An epipelagic, oceanic species occurring in waters of at least 20°C. Blackfin tuna frequently form large mixed schools with skipjack. Its spawning grounds are believed to be located well offshore. Around Florida the spawning season extends from April to November with a peak in May, while in the Gulf of Mexico it apparently lasts from June to September. No fecundity estimate is available. Males predominate in catches of adult fish.

Surface and deepsea fishes, squids, amphipods, shrimps, crabs, and stomatopods and decapod larvae form the food basis of blackfin tuna. It competes for food with skipjack tuna and is occasionally even preyed upon by this species. Other predators include Atlantic blue marlin (Makaira nigricans) and common dolphinfish (Coryphaena hippurus).

Preliminary studies suggest that blackfin tuna may become older than 5 years.

**Size :** Maximum fork length is 100 cm; common to 72 cm and 6 to 7 kg of weight (approximately 5 years of age). The all-tackle angling record is a 19.05 kg fish with a fork length of 100 cm taken in Bermuda in 1978.

**Interest to Fisheries :** The largest fishery for the species operates off the southeastern coast of Cuba and uses live-bait and pole. This is a mixed fishery directed also at Katsuwonus pelamis, but the catches are not separated. Blackfin tuna are also caught off Haiti and casually throughout the Lesser Antilles with various gear. In the important sports fisheries for the species in Florida and the Bahamas, trolling is the major method. In the period from 1975 to 1980 the world catch of this species ranged between 781 and 300 metric tons but peaked at 845 metric tons in 1981 (FAO, 1983).

**Local Names :** CUBA: Albacora; GUADELOUPE: Giromón, Thon noir; HAITI: Bonite, Deep-bodied tunny; JAPAN: Mini maguro, Monte maguro, Taiseiyo maguro; MARTINIQUE: Bonite noir, Petit thon; PORTUGAL: Albacorinha; SPAIN: Atún aleta negra; ST. LUCIA: Thon nuit; USA: Blackfin tuna; USSR: Atlanticheskyj tunets, Chernij tunets; VENEZULEA: Atún aleta negra.

**Literature :** De Sylva (1955); Idyll & De Sylva (1963); Nomura & Cruz (1967, Brazil, gives length and weight data); Beardsley & Simmons (1971, bibliography); Collette (1978, Species Identification Sheets, Western Central Atlantic).

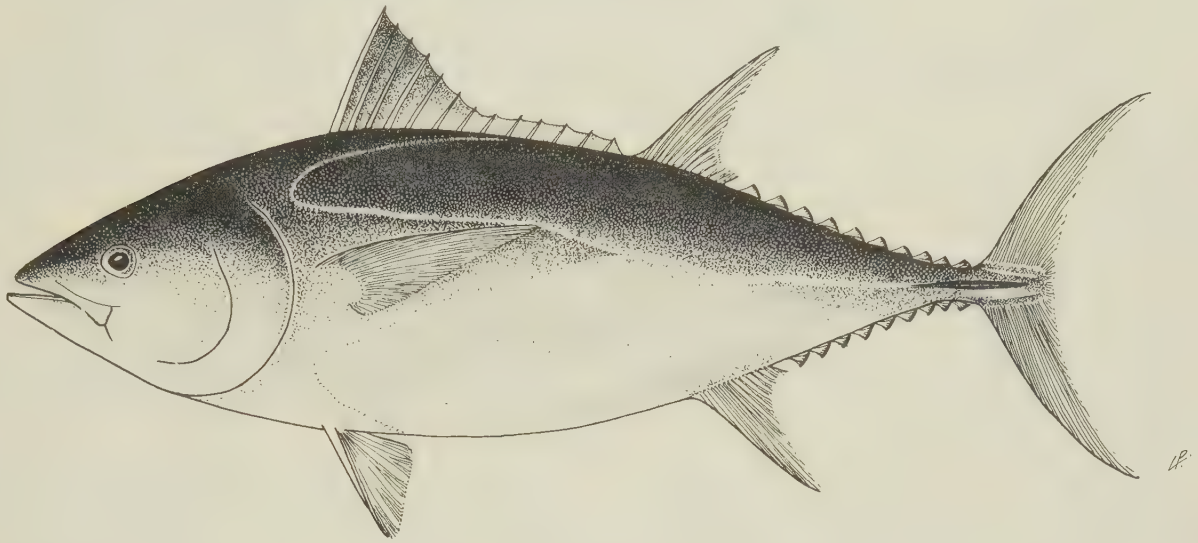
**Thunnus maccoyii** (Castelnau, 1872)

SCOMBR Thun 4

Thunnus maccoyii Castelnau, 1872, Proc.Zool.Acclim.Soc.Victoria, 1:104-105 (Melbourne, Australia).

**Synonymy :** Thunnus phillipsi Jordan & Evermann, 1926; Thunnus maccoyii - Jordan & Evermann, 1926; Thunnus thynnus maccoyii - Serventy, 1956.

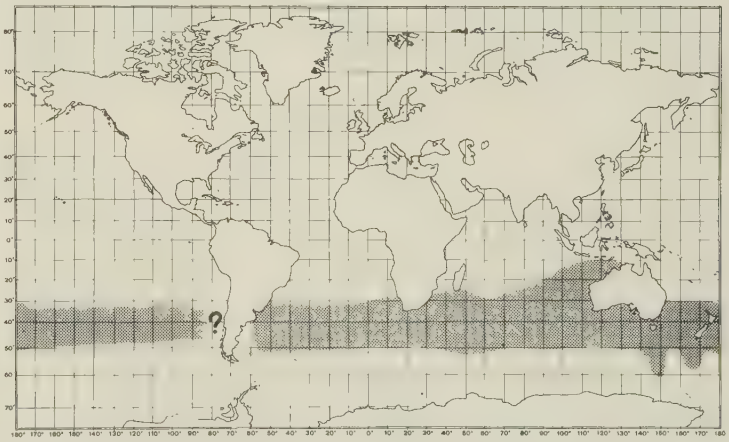
**FAO Names :** En - Southern bluefin tuna; Fr - Thon rouge du sud; Sp - Atún del sur.



**Diagnostic Features :** A very large species, deepest near middle of first dorsal fin base. Gillrakers 31 to 40 on first arch. Pectoral fins very short, less than 80% of head length (or between 20.2 and 23% of fork length), never reaching the interspace between the dorsal fins. Ventral surface of liver striated. Swimbladder present. Vertebrae 18 precaudal plus 21 caudal. Colour: lower sides and belly silvery white with colourless transverse lines alternated with rows of colourless dots (the latter dominate in older fish), visible only in fresh specimens; first dorsal fin yellow or bluish; anal fin and finlets dusky yellow edged with black; median caudal keel yellow in adults.

*T. maccoyii*

**Geographical Distribution :** Probably found throughout the Southern Ocean south of 30°S.




**Habitat and Biology :** Epipelagic, oceanic in cold temperate waters, confined to temperatures between 5° and 20°C for much of its life span; spawning fish and larvae, however, are encountered in waters with surface temperatures between 20° and 30°C.

In adults, seasonal migrations are observed between the warm water western and northwestern Australian spawning grounds (maximum catches are recorded at temperatures between 23° and 26°C) and coldwater feeding grounds off Tasmania and New Zealand (at temperatures of 13° to 15°C). The spawning season extends throughout the southern summer from about September/October to March. Fecundity of a 158 cm long female with gonads weighing about 1.7 kg each was estimated at about 14 to 15 million eggs.

The food spectrum, covering a wide variety of fishes (cold and warm water species from different depth strata), crustaceans, molluscs, salps and other groups, reveals the southern bluefin tuna as an opportunist. It is in turn preyed upon by sharks, dolphins, seals and billfishes.

Longevity is believed to be at least 12 years, older specimens being rarely encountered. One 3-year old individual was tagged off Albany, Australia, and recaptured off South Australia after 15 years and 4 months, suggesting that this species may attain an age of 20 years.

**Size :** Maximum fork length is 225 cm (Yukinawa, 1970). In the Indian Ocean, common sizes range between 160 to 200 cm fork length (Silas & Pillai, 1982). The all-tackle angling record is a 158 kg fish with a fork length of 203 cm taken off Whakatane, New Zealand in 1981. Length-weight correlations vary, particularly in adult fish in relation to physiological condition. A 180 cm long southern bluefin tuna may have a gutted weight of roughly 102 to 134 kg. Length at first maturity is estimated by circumstancial evidence at 130 cm, equivalent to about 40 kg of weight.

**Interest to Fisheries :** Southern bluefin tuna is an important commercial species, especially off Australia. Between 1975 and 1981 the world catch varied between a maximum of 43 223 metric tons (in 1976) and a minimum of 32 415 metric tons (in 1978). Japan and Australia landed the bulk of the catches (34 755 out of a total of 34 970 metric tons in 1981) (FAO, 1983). The major surface fishing grounds are found off New South Wales (peak catches in November and December) and in South Australian coastal waters (peak season February through April). Initially, in the fifties and early sixties, trolling was the dominant fishing technique but it was subsequently replaced by live-bait-and-pole fishing. Recently a specialized fishery for sashimi-quality has been developed by New Zealand fishermen.

The main longline fishing grounds extend from $10^{o}$ to $170^{o}$W with concentrations off Tasmania, New Zealand and South Africa. They shift seasonally associated with changes in hydrographical conditions. With the introduction of monthly sea surface temperature charts as an aid in fish locating, fishing operations increased their efficiency. On the Tasmanian and New Zealand grounds the fishing season peaks from June through September, and off Cape Town, from May to August, as expressed by maximum hook rates. Adult fish (over 130 cm fork length) are predominantly caught off New Zealand, Tasmania and on the Western Australian (spawning) longline fishing grounds.

This species is prized for the sashimi markets of Japan, and individual fish have brought more than US$ 10 000 on the auction in Tokyo. Market prices change dramatically with the fat contents i.e. quality of the meat. Fat prespawning southern bluefin tuna fetch high prices while spent individuals meet low appreciation.

A management scheme for the conservation of the stock is in operation. It involves an increase in the age at first capture through a voluntary scheme of closed seasons in areas where juveniles and up to 5-year-old fish aggregate; likewise, the Australian government has imposed restrictions on the number of boats allowed to operate within its waters.

**Local Names :** AUSTRALIA: Southern bluefin tuna, Southern tunny; CHILE: Atún; JAPAN: Bachi maguro, Indo (Goshu) maguro, Minami maguro; NEW ZEALAND: Bluefin tuna, Tunny; SOUTH AFRICA: Southern bluefin tuna, Suidelike blouvin-tuna; USSR: Avstralijskaya tunets.

**Literature :** Serventy (1956); Robins (1963); Fischer & Whitehead, eds (1974, Species Identification Sheets, Eastern Indian Ocean/Western Central Pacific); Olson (1980, summarizes i.e. growth parameter estimates); Shingu (1981, reports i.e. population parameters).

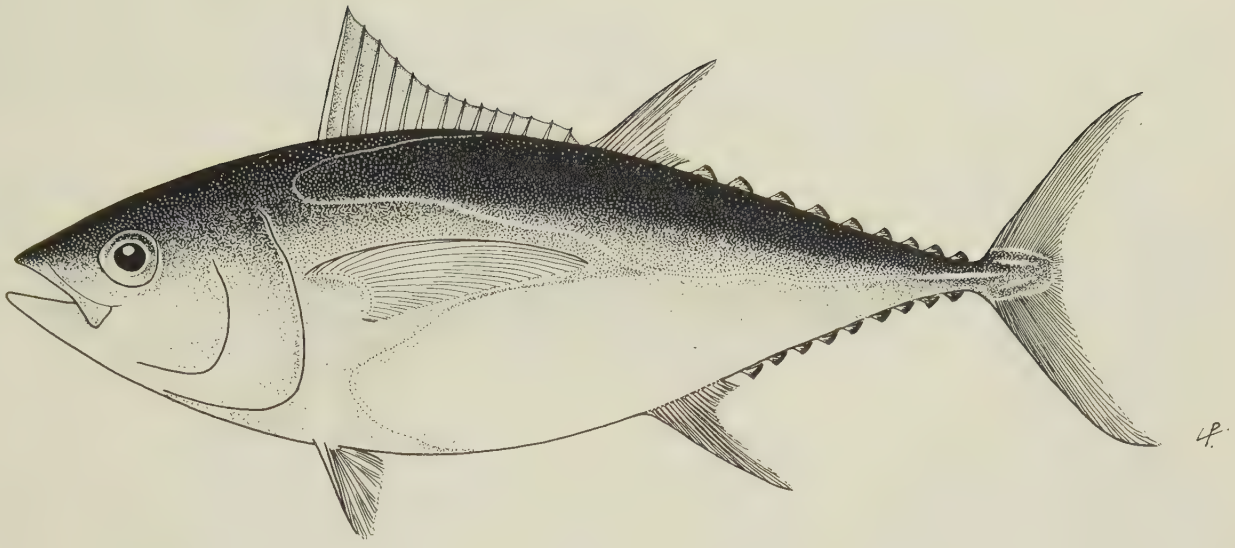
**Thunnus obesus** (Lowe, 1839)

SCOMBR Thun 5

Thynnus obesus Lowe, 1839, Proc.Zool.Soc.London, 7:78 (Madeira).

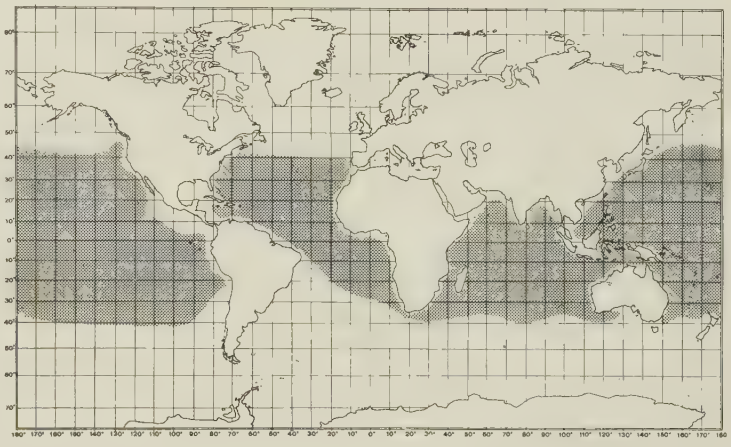
**Synonymy :** Thynnus sibi Temminck & Schlegel, 1844; Orcynus sibi - Kitahara, 1897; Germo sibi - Jordan & Snyder, 1901; Thunnus sibi - Jordan & Snyder, 1901; Thunnus mebachi Kishinouye, 1915; Parathunnus mebachi - Kishinouye, 1923; Parathunnus sibi - Jordan & Hubbs, 1925; Parathunnus obesus - Jordan & Evermann, 1926; Germo obesus - Fowler, 1936; Thunnus obesus - Fraser-Brunner, 1950; Neothunnus obesus - Postel, 1950; Parathunnus obesus mebachi - Jones & Silas, 1961; Thunnus obesus sibi - Jones & Silas, 1963a; Thunnus obesus mebachi - Jones & Silas, 1964.

**FAO Names :** En - Bigeye tuna; Fr - Thon obèse; Sp - Patudo.



**Diagnostic Features:** A large species, deepest near middle of first dorsal fin base. Gillrakers 23 to 31 on first arch. Pectoral fins moderately long (22 to 31% of fork length) in large individuals (over 110 cm fork length), but very long (as long as in T. alalunga) in smaller individuals (though in fish shorter than 40 cm they may be very short). In fish longer than 30 cm, ventral surface of liver striated. Swimbladder present. Vertebrae 18 precaudal plus 21 caudal. Colour: lower sides and belly whitish; a lateral iridescent blue band runs along sides in live specimens; first dorsal fin deep yellow, second dorsal and anal fins light yellow, finlets bright yellow edged with black.

**Geographical Distribution:** Worldwide in tropical and subtropical waters of the Atlantic, Indian and Pacific oceans, but absent from the Mediterranean.



**Habitat and Biology:** Epipelagic and mesopelagic in oceanic waters, occurring from the surface to about 250 m depth. Temperature and thermocline depth seem to be the main environmental factors governing the vertical and horizontal distribution of bigeye tuna. Water temperatures in which the species has been found range from 13° to 29°C, but the optimum range lies between 17° and 22°C. This coincides with the temperature range of the permanent thermocline. In fact, in the tropical western and central Pacific, major concentrations of T. obesus are associated with the thermocline rather than with the surface phytoplankton maximum. For this reason, variation in occurrence of the species is closely related to seasonal and climatic changes in surface temperature and thermocline.

Juveniles and small adults of bigeye tuna school at the surface in mono-species groups or together with yellowfin tuna and/or skipjack. Schools may be associated with floating objects.

In the eastern Pacific some spawning is recorded between 10°N and 10°S throughout the year, with a peak from April through September in the northern hemisphere and between January and March in the southern hemisphere. Kume (1967) found a correlation between the occurrence of sexually inactive bigeye tuna and a decrease of surface temperature below 23° or 24°C. Mature fish spawn at least twice a year; the number of eggs per spawning has been estimated at 2.9 million to 6.3 million.

The food spectrum of bigeye tuna covers a variety of fish species, cephalopods and crustaceans, thus not diverging significantly from that of other similar-sized tunas. Feeding occurs in daytime as well as at night. The main predators are large billfish and toothed whales.

**Size :** Maximum fork length over 200 cm; common to 180 cm (corresponding to an age of at least 3 years). The all-tackle angling record for the Pacific is a 197.3 kg fish from off Cabo Blanco, Peru in 1957. This fish was 236 cm long but it was not specified whether this pertained to fork length or total length. For the Atlantic, the all-tackle angling record is a 170.3 kg fish with a fork length of 206 cm taken off Ocean City, Maryland, USA in 1977. Maturity seems to be attained at 100 to 130 cm fork length in the eastern Pacific and in the Indian Ocean, and at about 130 cm in the central Pacific.

**Interest to Fisheries :** Catch statistics are reported by 17 countries for 14 fishing areas. Yearly catches of more than 10 000 metric tons are taken in Fishing Areas 34, 51, 61, 71, and 77 with more than two thirds of the total taken in the Pacific up to 1980. Among the countries reporting bigeye tuna catches Japan ranks first, followed by the Republic of Korea with much lower landings. The world catch increased from about 164 000 metric tons in 1974 to 201 000 metric tons in 1980 reaching a peak of 214 000 metric tons in 1977 (FAO, 1981). For 1981 a decrease to about 167 000 metric tons was estimated (FAO, 1983). In the Indian Ocean, the bigeye tuna fishery was dominated by Japanese fleets up to the end of the sixties, but subsequently operations of vessels from the Republic of Korea became more important, and have accounted for more than 60% of the catch in the late seventies.

The most important fishing gear, at least in the Pacific, are longlines, which comprise some 400 'baskets' (consisting of 5 branch lines, each with a baited hook) extending over up to 130 km. Species commonly used as bait include (frozen) Pacific saury (Cololabis saira), chub mackerel (Scomber japonicus), jack mackerel (Trachurus) and squid. Day- and night-time operations are common throughout the year, but there are seasonal variations in apparent abundance reflected in changes of fishing effort. In the seventies, deep longlines employing between 10 and 15 branch lines per basket were introduced. This new type of gear is theoretically capable of fishing down to 300 m depth, as compared to the usual 170 m reached by traditional longline gear. Catch rates increased for about 3 years and then declined to previous levels again, suggesting that only a portion of the bigeye resources are exploited.

Bigeye tuna is exploited in increasing quantities as associated catch of the spring and summer pole-and-line fishery in the northwestern Pacific, and of the purse seine fishery in the eastern Pacific, both directed primarily at skipjack and yellowfin tuna. In Japan, its meat is highly priced and processed into sashimi in substitution for bluefin tuna.

**Local Names :** ARGENTINA: Ojos grandes, Patudo; BRAZIL: Albacora bandolim; CHILE: Atún de ojo grande; COLOMBIA: Atún; CUBA: Ojigrande; ECUADOR: Albacora, Atún ojo grande; FRANCE: Patudo, Thon aux grands yeux, Thon obèse, Thon ventru; GERMANY FR: Grossaugenthun; JAPAN: Bachi, Daruma, Darumeji, Mebachi, Mebuto; MARTINIQUE: Patudo, Thon obèse; NETHERLANDS: Storje, Grootoogtonijn; PACIFIC ISLANDS TRUST TERRITORIES: Aáhi o'opa, Aáhi tatumu; PERU: Atún ojo grande, Patudo; POLAND: Opastun; PORTUGAL: Albacora-ôlho-grande, Atum patudo; SENEGAL: Thon obèse; SOUTH AFRICA: Bigeye tuna, Grootoog-tuna; SPAIN: Patudo; UK: Bigeye tuna; USA: Bigeye tuna; USSR: Bolsheglazyj tunets; VENEZUELA: Atún ojo gordo; YUGOSLAVIA: Zutoperajni tunj.

**Literature :** Mimura et al. (1936a, Indian Ocean); Alverson & Peterson (1963, Pacific); Fischer & Whitehead, eds (1974, Species Identification Sheets, Eastern Indian Ocean/Western Central Pacific); Collette (1978, Species Identification Sheets, Western Central Atlantic; 1981, Species Identification Sheets, Eastern Central Atlantic); Calkins (1980, Pacific).

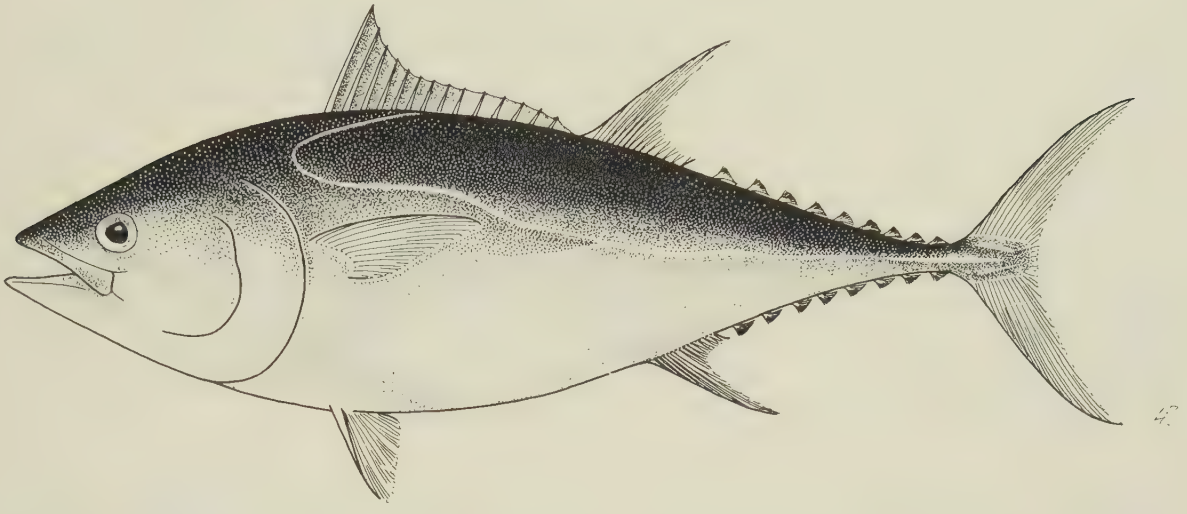
**Thunnus thynnus** (Linnaeus, 1758)

SCOMBR Thun 2

Scomber thynnus Linnaeus, 1758, Systema Naturae, ed. X:297-298.

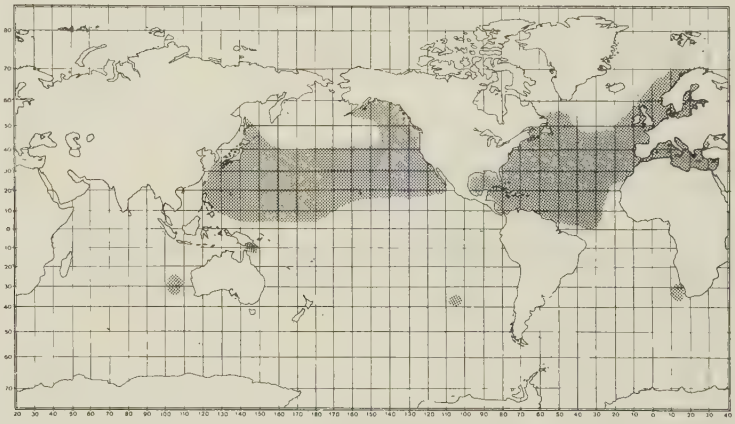
**Synonymy :** Thynnus thynnus - Cuvier, 1817; Thynnus mediterraneus Risso, 1826; Thynnus vulgaris Cuvier in Cuvier & Valenciennes, 1831; Thynnus orientalis Temminck & Schlegel, 1844; Thunnus vulgaris - South, 1845; Thynnus secundo-dorsalis Storer, 1855; Orcynus thynnus - Poey, 1875; Orcynus secondidorsalis - Poey, 1875; Orcynus schlegelii Steindachner in Steindachner & Döderlein, 1884; Albacora thynnus - Jordan, 1888; Thunnus thynnus - Jordan & Evermann, 1896; Thunnus schlegelii - Jordan & Snyder, 1900; Thunnus orientalis - Jordan & Snyder, 1900; Thunnus secundodorsalis - Jordan & Evermann, 1926; Thunnus saliens Jordan & Evermann, 1926; Thunnus thynnus thynnus Serventy, 1956; Thunnus thynnus coretta - Serventy, 1956; Thunnus thynnus orientalis - Serventy, 1956; Thunnus thynnus saliens - Serventy, 1956.

**FAO Names :** En - Northern bluefin tuna; Fr - Thon rouge; Sp - Atún.



**Diagnostic Features :** A very large species, deepest near middle of first dorsal fin base. Gillrakers 34 to 43 on first arch. Second dorsal fin higher than first dorsal; pectoral fins very short, less than 80% of head length (16.8 to 21.% of fork length), never reaching the interspace between the dorsal fins. Ventral surface of liver striated. Swimbladder present. Vertebrae 18 precaudal plus 21 caudal. Colour: lower sides and belly silvery white with colourless transverse lines alternated with rows of colourless dots (the latter dominate in older fish), visible only in fresh specimens; first dorsal fin yellow or bluish; the second reddish-brown; anal fin and finlets dusky yellow edged with black; median caudal keel black in adults.

**Geographical Distribution :** There are at least 2 subspecies, one in the Atlantic and one in the Pacific. The Atlantic subspecies is found from Labrador and Newfoundland south into the Gulf of Mexico and the Caribbean Sea and is also known off Venezuela and Brazil in the western Atlantic; in the eastern Atlantic it occurs from the Lofoten Islands off Norway south to the Canary Islands and the Mediterranean Sea. There is also a population off South Africa. The Pacific subspecies is known from the Gulf of Alaska to southern California and Baja California in the eastern Pacific; in the western Pacific, it occurs from Sakhalin Island in the southern Sea of Okhotsk south to the northern Philippines.



**Habitat and Biology :** Epipelagic, usually oceanic but seasonally coming close to shore. Northern bluefin tuna tolerate a wide range of temperatures. Up to a size of 40 to 80 kg, they school by size, sometimes together with albacore, yellowfin, bigeye, skipjack, frigate tuna, eastern Pacific bonito and/or yellowtail amberjack (Seriola lalandi).

In the northeastern Pacific, T. thynnus tend to migrate northward along the coast of Baja California and California from June to September. Off the Pacific coast of Japan they migrate northward in summer and southward during winter. Large fish may enter the Sea of Japan from the south in early summer and move as far north as the Okhotsk Sea; most leave the Sea of Japan through Tsugara Strait, north of Honshu.

Onset of maturity is at about 4 or 5 years, and large adults (age 10+) are known to spawn in the Gulf of Mexico and in the Mediterranean Sea. In the Pacific, spawning occurs northeast of the Philippines. In recent surveys, larvae have been discovered east of the Kuroshio, in the transitional fronts. Females weighing between 270 to 300 kg may produce as many as 10 million eggs per spawning season.

Variations in the food spectrum are attributed primarily to behavioural differences in feeding. 'Vigorous pursuit' would be required to prey on small schooling fishes (anchovies, sauries, hakes) or on squids, while 'modified filter-feeding' is used to feed on red crabs and other less agile organisms.

In turn, northern bluefin tuna are preyed upon by killer whales (Orcinus orca), pilot whales and blackfish. However, the rather large size of adults drastically reduces the number of potential predator species.

**Size :** Maximum fork length over 300 cm; common to 200 cm. The all-tackle angling record is a 679 kg fish of 304 cm fork length taken off Aulds Cove, Nova Scotia in 1979. The biggest fish in the various North Atlantic fisheries range between 540 and 560 kg in recent years. In the warmer waters off the Canary Islands, the biggest fish in commercial catches range between 350 and 400 kg.

**Interest to Fisheries :** Catch statistics were reported by 25 countries for 9 fishing areas, Fishing Area 61 alone accounting for almost half the total. The country taking the largest catches of northern bluefin tuna is Japan (28 628 metric tons in 1981), and it operates in almost all fishing areas with its long-distance fleets. World catches of T. thynnus have remained more or less stable oscillating around 36 000 metric tons between 1975 and 1980, while in 1981 they increased to 46 000 metric tons (FAO, 1983). T. thynnus is caught with different types of gear, such as purse seines, longlines, trolling lines, trap nets and others. Some of the oldest fisheries documented are Mediterranean trap fisheries. Off Sicily, northern bluefin tuna are traditionally caught in the 'tonnare', or by harpooning from the 'antenna' vessels. Traps similar to the 'tonnare' are also used off southern Spain and Morocco. The species also formed the basis of ancient specialized fisheries off the eastern USA and Canada, and is presently avidly sought by big game fishermen on hook-and-line. It is marketed fresh or deep frozen in Japan; the belly portion fetches particularly high prices when containing much fat.

In late 1982, the International Commission for the Conservation of Atlantic Tunas (ICCAT) increased the 1983 catch limit for the western Atlantic to 2 660 metric tons. This quota is subsequently divided among the contracting parties (Canada, Japan and USA). Concern about the continued low level of abundance of small northern bluefin tuna resulted in an ICCAT decision to limit the catch of fish smaller than 120 cm to 15% by weight of the total catch in the western Atlantic. In these waters, the fisheries are also controlled through number of licences, limitation of fishing season, minimum size and maximum-catch-per-boat-and-day-regulations. The sportfishing boats are also obliged to report a descriptive log of their operations on a weekly basis, and use prescribed gear.

**Local Names :** ANGOLA: Atum, Rabilha; ARGENTINA: Atún aleta azul, Atún rojo; BRAZIL: Atum; BULGARIA: Ton; CHILE: Atún cimarrón, Atún de aleta azul; CHINA: Cá chan, Thu; COLOMBIA: Atún, Atún de aleta azul; CUBA: Atún aleta azul; DENMARK: Thunfisk; DOMINICAN REPUBLIC: Atún; EGYPT: Tunna; FINLAND: Tonnikala; FRANCE: Thon rouge; GERMANY FR: Roter Thun; GREECE: Tónnos; ICELAND: Túnfiskur; ISRAEL: Tunna kehula; ITALY: Tonno; JAPAN: Honmaguro, Kuro maguro, Kuromeji, Yokowa (young); MALTA: Tonn; MARTINIQUE: Thon rouge; MEXICO: Atún de aleta azul; MOROCCO: Thone; MONACO: Tono; NETHERLANDS: Tonijn; NORWAY: Makrellstørje, Sjorje, Thunfisk; PERU: Atún de aleta azul; POLAND: Ton; PORTUGAL: Atum; ROMANIA: Ton, Ton rosu; SOUTH ARICA: Blouvin-tuna, Bluefin tuna; SPAIN: Atún; SWEDEN: Makrilstörje, Röd tonfisk, Tonfisk; TUNISIA: Toun ahmar; TURKEY: Orkinos; UK: Bluefin tuna, Tunny; URUGUAY: Aleta azul, Atún rojo; USA: Bluefin tuna; USSR: Solsheglazyj tunets, Krasnyj tunets, Sineperyj tunets, Sinij tunets, Vostochnyj tunets, Zoludoj tunets; VENEZUELA: Atún aleta azul; YUGOSLAVIA: Tun.

**Literature :** Bell (1963, eastern Pacific); Tiews (1963, Atlantic); Yamanaka et al. (1963, Pacific); Fischer, ed. (1973, Species Identification Sheets, Mediterranean and Black Sea); Collette (1978, Species Identification Sheets, Western Central Atlantic; 1981, Species Identification Sheets, Eastern Central Atlantic); Bayliff (1980a, Pacific, summarizes i.e. growth parameters); Farrugio (1980, gives growth data on Mediterranean bluefin tuna); Aloncle et al. (1981).

**Remarks :** Two subspecies were recognized by Gibbs & Collette (1967): T. thynnus thynnus (Linnaeus) in the North Atlantic and T. thynnus orientalis Temminck & Schlegel in the North Pacific.

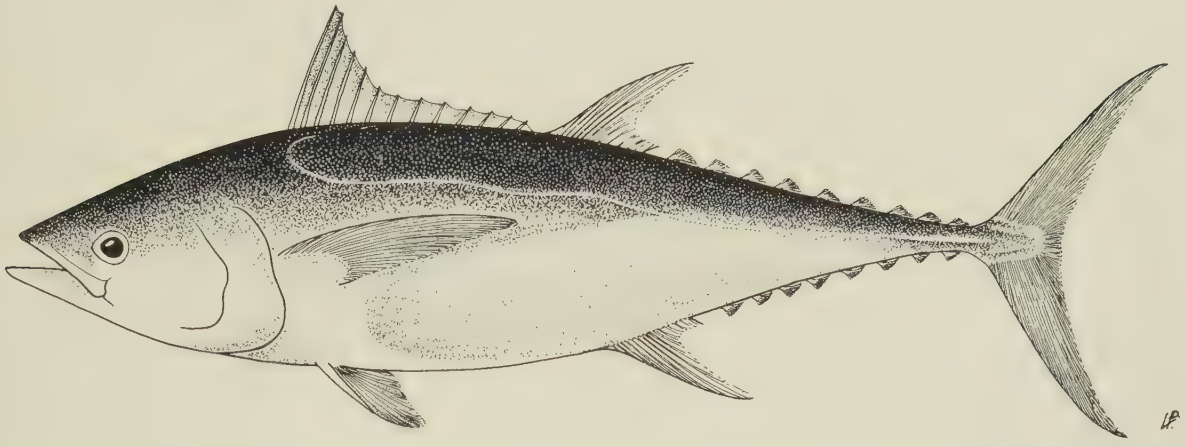
**Thunnus tonggol** (Bleeker, 1851)

SCOMBR Thun 6

Thynnus tonggol Bleeker, 1851a, Natur.Tidschr.Ned.Ind., 1:356-357 (Batavia Sea).

**Synonymy :** Thunnus rarus Kishinouye, 1915; Neothunnus rarus - Kishinouye, 1923; Kishinoella rara - Jordan & Hubbs, 1925; Neothunnus tonggol - Jordan & Evermann, 1926; Thunnus nicholsoni Whitley, 1936; Thunnus tonggol - Tortonese, 1939; Kishinoella tonggol - Serventy, 1941.

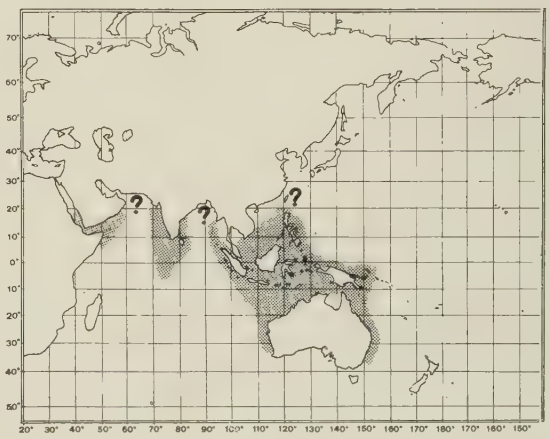
**FAO Names :** En - Longtail tuna; Fr - Thon mignon; Sp - Atún tongol.



**Diagnostic Features :** A small species, deepest near middle of first dorsal fin base. Gillrakers few, 19 to 27 on first arch. Second dorsal fin higher than first dorsal; pectoral fins short to moderately long, 22 to 31% of fork length in smaller specimens (under 60 cm fork length) and 16 to 22% in larger individuals; ventral surface of liver not striated. Swimbladder absent or rudimentary. Vertebrae 18 precaudal plus 21 caudal. Colour: lower sides and belly silvery white with colourless elongate oval spots arranged in horizontally oriented rows; dorsal, pectoral and pelvic fins blackish, tip of second dorsal and anal fins washed with yellow; anal fin silvery; dorsal and anal finlets yellow with greyish margins; caudal fin blackish, with streaks of yellowish green.

liver

**Geographical Distribution :** Indo-West Pacific Ocean from Japan south through the Philippines to Papua New Guinea, New Britain, the northern three quarters of Australia (Twofold Bay, New South Wales to Freemantle, Western Australia) west through the East Indies to both coasts of India, southern Arabian Peninsula, the Red Sea and the Somalia coast.



**Habitat and Biology :** An epipelagic, predominantly neritic species avoiding very turbid waters and areas with reduced salinity such as estuaries. Longtail tuna may form schools of varying size. Being an opportunistic feeder, its diet includes many species of crustaceans, cephalopods and fishes, at varying percentages.

**Size :** Maximum fork length is about 130 cm. In the Indian Ocean, common fork lengths range between 40 and 70 cm (Silas & Pillai, 1982). The all-tackle angling record is a 35.9 kg fish of 136 cm fork length taken at Montagne Island, New South Wales, Australia, in 1982.

**Interest to Fisheries :** This species is known to be fished off Japan (but is very rare), the Philippines, Australia, Papua New Guinea, Indonesia, and India, but catch statistics were only reported for Australia and Papua New Guinea, ranging between only 9 and 59 metric tons per year in the period from 1975 to 1980. In 1981, catches of 350 metric tons were for the first time reported by the United Arab Emirates bringing the total to 368 metric tons in this year (FAO, 1983). This is doubtlessly a still gross underestimate of the actual landings of this species. Fishing gear comprise trolls, drift nets, and longlines.

**Local Names :** AUSTRALIA: Northern bluefin tuna; JAPAN: Koshinaga; USSR: Dlinnokhvostyj tunets.

**Literature :** Serventy (1956a, Australia); Jones (1963, Indian Ocean); Fischer & Whitehead, eds (1974, Species Identification Sheets, Eastern Indian Ocean/Western Central Pacific).

**Remarks :** Juveniles of this species, bluefin tuna, yellowfin tuna and bigeye tuna are very similar. Some of the records from Japanese waters may therefore be ascribed to misidentification.

## 3. LIST OF SPECIES BY MAJOR FISHING AREAS

| SPECIES | PAGE | GEOGRAPHICAL DISTRIBUTION | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | FRESH-WATERS | MAJOR MARINE FISHING AREAS FOR STATISTICAL PURPOSES | | | | | | | | | | | | | | | | | |
| | | | 18 | 21 | 27 | 31 | 34 | 37 | 41 | 47 | 48 | 51 | 57 | 58 | 61 | 67 | 71 | 77 | 81 | 87 | 88 |
| Acanthocybium solandri | 25 | | | | | ● | ● | ● | | ● | | ● | ● | | ● | | ● | ● | ● | | |
| Allothunnus fallai | 26 | | | | | | | | ● | ● | | ● | ● | | | | ● | ● | ● | ● | |
| Auxis spp. | 27 | | | ● | ● | ● | ● | ● | ● | ● | | ● | ● | | ● | | ● | ● | | | |
| Cybiosarda elegans | 31 | | | | | | | | | | | | ● | | | | ● | | ● | | |
| Euthynnus affinis | 33 | | | | | | | | | | | ● | ● | | ● | | ● | ● | ● | | |
| Euthynnus alletteratus | 34 | | | ● | ● | ● | ● | ● | ● | ● | | | | | | | | | | | |
| Euthynnus lineatus | 36 | | | | | | | | | | | | | | | | | ● | | ● | |
| Gasterochisma melampus | 37 | | | | | | | | ● | ● | | ● | ● | ● | | ● | | | ● | ● | |
| Grammatorcynus bicarinatus | 38 | | | | | | | | | | | | ● | | | | ● | | | | |
| Grammatorcynus bilineatus | 39 | | | | | | | | | | | ● | ● | | ● | | ● | | | | |
| Gymnosarda unicolor | 40 | | | | | | | | | | | ● | ● | | ● | | ● | ● | | | |
| Katsuwonus pelamis | 42 | | | ● | ● | ● | ● | ● | ● | ● | | ● | ● | | ● | ● | ● | ● | ● | ● | |

| SPECIES | PAGE | GEOGRAPHICAL DISTRIBUTION | | | | | | | | | | | | | | | | | | | |
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| | | FRESH-WATERS | MAJOR MARINE FISHING AREAS FOR STATISTICAL PURPOSES | | | | | | | | | | | | | | | | | | |
| | | | 18 | 21 | 27 | 31 | 34 | 37 | 41 | 47 | 48 | 51 | 57 | 58 | 61 | 67 | 71 | 77 | 81 | 87 | 88 |
| Orcynopsis unicolor | 44 | | | | ● | | ● | ● | | | | | | | | | | | | | |
| Rastrelliger brachysoma | 46 | | | | | | | | | | | | ● | | | | ● | | | | |
| Rastrelliger faughni | 47 | | | | | | | | | | | | ● | | ● | | ● | | | | |
| Rastrelliger kanagurta | 48 | | | | | | | ● | | | | ● | ● | | ● | | ● | | | | |
| Sarda australis | 50 | | | | | | | | | | | | ● | | | | | | ● | | |
| Sarda chiliensis | 51 | | | | | | | | | | | | | | | ● | | ● | | ● | |
| Sarda orientalis | 52 | | | | | | | | | ● | | ● | ● | | ● | | ● | ● | | | |
| Sarda sarda | 53 | | | ● | ● | ● | ● | ● | ● | ● | | | | | | | | | | | |
| Scomber australasicus | 55 | | | | | | | | | | | | ● | | ● | | ● | ● | ● | | |
| Scomber japonicus | 56 | | | ● | ● | ● | ● | ● | ● | ● | | ● | | | ● | ● | ● | ● | | ● | |
| Scomber scombrus | 58 | | | ● | ● | ● | ● | ● | | | | | | | | | | | | | |
| Scomberomorus brasiliensis | 60 | | | | | ● | | | ● | | | | | | | | | | | | |
| Scomberomorus cavalla | 61 | | | ● | | ● | ● | | ● | | | | | | | | | | | | |
| Scomberomorus commerson | 63 | | | | | | | ● | | ● | | ● | ● | | ● | | ● | | ● | | |

| SPECIES | PAGE | GEOGRAPHICAL DISTRIBUTION | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | FRESH-WATERS | MAJOR MARINE FISHING AREAS FOR STATISTICAL PURPOSES | | | | | | | | | | | | | | | | | |
| | | | 18 | 21 | 27 | 31 | 34 | 37 | 41 | 47 | 48 | 51 | 57 | 58 | 61 | 67 | 71 | 77 | 81 | 87 | 88 |
| Scomberomorus concolor | 64 | | | | | | | | | | | | | | | | | ● | | | |
| Scomberomorus guttatus | 65 | | | | | | | | | | | ● | ● | | ● | | ● | | | | |
| Scomberomorus koreanus | 66 | | | | | | | | | | | ● | ● | | ● | | ● | | | | |
| Scomberomorus lineolatus | 68 | | | | | | | | | | | ● | ● | | | | ● | | | | |
| Scomberomorus maculatus | 69 | | | ● | | ● | | | | | | | | | | | | | | | |
| Scomberomorus multiradiatus | 70 | | | | | | | | | | | | | | | | ● | | | | |
| Scomberomorus munroi | 71 | | | | | | | | | | | | ● | | | | ● | | ● | | |
| Scomberomorus niphonius | 72 | | | | | | | | | | | | | | ● | | | | | | |
| Scomberomorus plurilineatus | 73 | | | | | | | | | ● | | ● | | | | | | | | | |
| Scomberomorus queenslandicus | 74 | | | | | | | | | | | | ● | | | | ● | | ● | | |
| Scomberomorus regalis | 75 | | | ● | | ● | | | ● | | | | | | | | | | | | |
| Scomberomorus semifasciatus | 76 | | | | | | | | | | | | ● | | | | ● | | | | |
| Scomberomorus sierra | 77 | | | | | | | | | | | | | | | | | ● | | ● | |
| Scomberomorus sinensis | 78 | ● | | | | | | | | | | | | | ● | | ● | | | | |

| SPECIES | PAGE | GEOGRAPHICAL DISTRIBUTION | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | FRESH-WATERS | MAJOR MARINE FISHING AREAS FOR STATISTICAL PURPOSES | | | | | | | | | | | | | | | | | | |
| | | | 18 | 21 | 27 | 31 | 34 | 37 | 41 | 47 | 48 | 51 | 57 | 58 | 61 | 67 | 71 | 77 | 81 | 87 | 88 |
| Scomberomorus tritor | 79 | | | | | | ● | ● | | ● | | | | | | | | | | | |
| Thunnus alalunga | 81 | | | ● | ● | ● | ● | ● | ● | ● | | ● | ● | | ● | ● | ● | ● | ● | ● | |
| Thunnus albacares | 83 | | | ● | ● | ● | ● | | ● | ● | | ● | ● | | ● | | ● | ● | ● | ● | |
| Thunnus atlanticus | 85 | | | ● | | ● | | | ● | | | | | | | | | | | | |
| Thunnus maccoyii | 87 | | | | | | | | ● | ● | ● | ● | ● | ● | | | | | ● | ● | |
| Thunnus obesus | 88 | | | ● | ● | ● | ● | | ● | ● | | ● | ● | | ● | ● | ● | ● | ● | ● | |
| Thunnus thynnus | 90 | | | ● | ● | ● | ● | ● | | ● | | | ● | | ● | ● | ● | ● | ● | | |
| Thunnus tonggol | 92 | | | | | | | | | | | ● | ● | | ● | | ● | | ● | | |

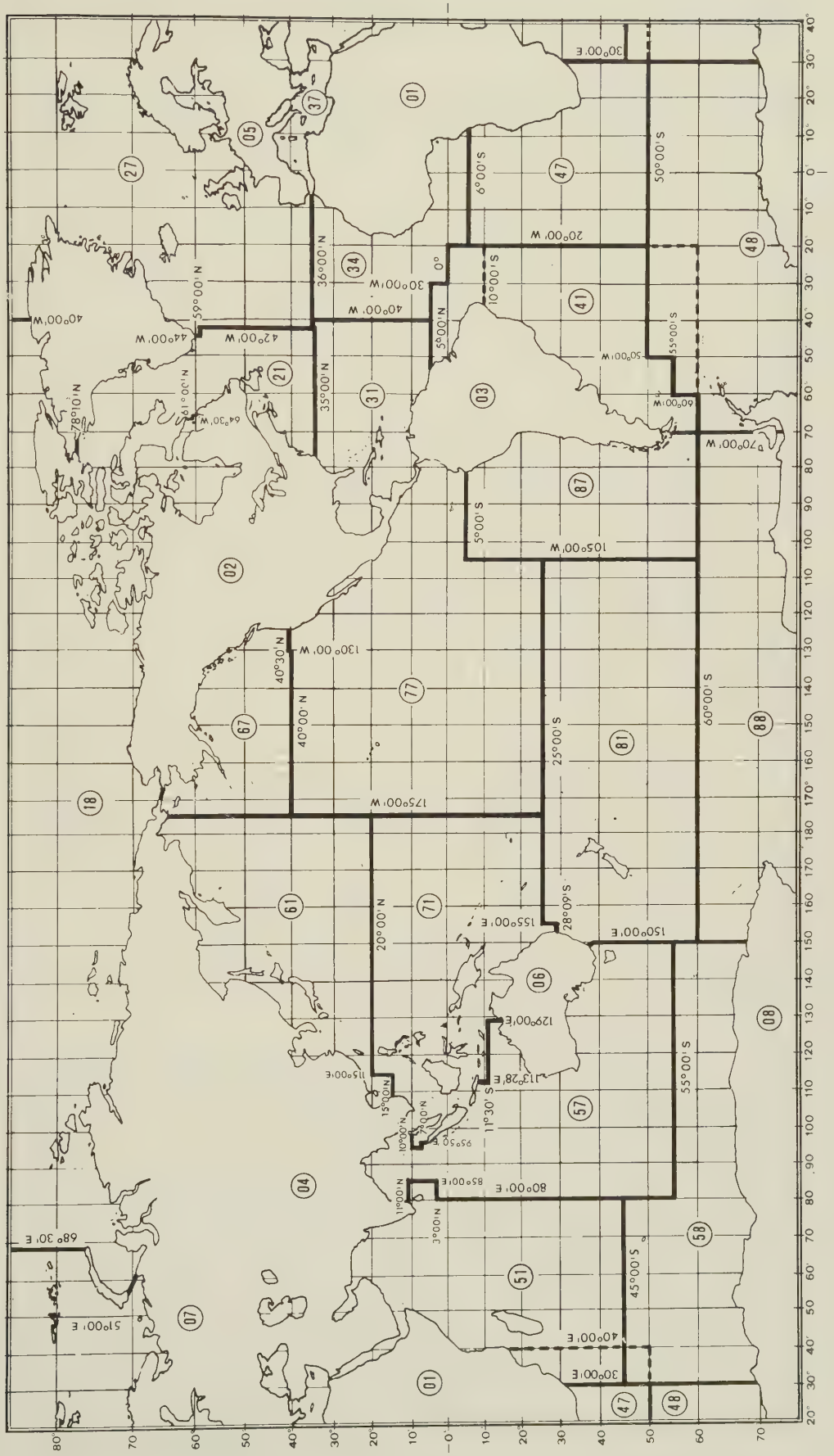

Fig. 81 Major Fishing Areas for statistical purposes

## 4. BIBLIOGRAPHY


Abe, T. & Y. Takashima, 1958 Differences in the number and position of two kinds of fin-supports of the spinous dorsal in the Japanese mackerels of the genus Pneumatophorus. Jap.J.Ichthyol., 7(1):1-11

Agassiz, L., 1874 Pisces Celebes. Icones Piscium. London, 4 pls.

Alcantara, Filho, P. de, 1972 Sôbre a captura da serra, Scomberomorus maculatus (Mitchill), com redes-de-espera, no Estado do Ceará. Arq.Ciênc.Mar, Fortaleza, 12(1):77-84

_____, 1972a Sôbre a captura da cavala, Scomberomorus cavalla (Cuvier), com redes-de-espera, no Estado do Ceará. Arq.Ciênc.Mar, Fortaleza, 12(2):133-8

Aloncle, H., et al., 1981 Seventh report of the bluefin tuna working group Copenhagen. Coop.Res.Rep.ICES, (100):70 p.

Alverson, F.G. & C.L. Peterson, 1963 Synopsis of biological data on bigeye tuna Parathunnus sibi (Temminck and Schlegel, 1844). FAO Fish.Rep., (6) vol.2:482-514

Ancieta Calderón, F., 1964 Sinopsis sobre la biología y pesquería del "Bonito" Sarda chilensis (Cuvier y Valenciennes) frente a la costa del Perú. Rev.Fac.Cienc.Biol.Univ.Nac.Trujillo, 1(1):17-49

Artunduaga Pastrana, E., 1976 La sierra (Scomberomorus sierra Jordan y Starks) del Pacífico colombiano. Divulg. Pesq.Inst.Desarr.Recurs.Nat.Renov.Bogotá, 8(4-5):1-72

Aubenton, F. d' & M. Blanc, 1965 Etude systématique et biologique de Scomberomorus sinensis (Lacepède, 1802), poissons des eaux douces du Cambodge. Bull.Mus.Natl.Hist.Nat.Paris (2ème Sér.), 37(2):233-43

Ayres, W.O., 1857 Description of a new species of mackerel, Scomber diego, Ayres. Proc.Calif.Acad.Sci., 1:92

Banerjee, M.K. & R.D. Chakrabarty, 1972 Drift gill-netting in Lower Sundarbans, West Bengal. Indian J.Fish., 16 (1-2):75-81

Bard, F.X., 1981 Le thon germon (Thunnus alalunga Bonnaterre, 1788), de l'Océan Atlantique. De la dynamique des populations à la stratégie démographique. Thèse de Doctorat d'Etat des Sciences Naturelles présentée à l'Université Pierre et Marie Curie, Paris, 335 p. (MS)

Barnard, K.H., 1927 A monograph of the marine fishes of South Africa. Ann.S.Afr.Mus., 21(2):419-1065

Bastos, J., et al., 1973 Sôbre a elaboração de conservas de pescado em leite de côco e em óleos de algodão e de babaçu. Arq.Ciênc.Mar, Fortaleza, 13(1):25-9

Bayliff, W.H. (ed.), 1980 Synopses of biological data on eight species of scombrids. Spec.Rep.I-ATTC, (2):530 p.

_____, 1980a Synopsis of biological data on the northern bluefin tuna, Thunnus thynnus (Linnaeus, 1758), in the Pacific Ocean. Spec.Rep.I-ATTC, (2):261-93

Beardsley, G.L., Jr. & W.J. Richards, 1970 Size, seasonal abundance, and length-weight relation of some scombrid fishes from southeast Florida. NOAA Tech.Rep.NMFS (Spec.Sci.Rep.-Fish.Ser.), (595):6 p.

Beardsley, G.L. & D.C. Simmons, 1971 A bibliography of the blackfin tuna, Thunnus atlanticus (Lesson). NOAA Tech.Rep.NMFS (Spec.Sci.Rep.-Fish.Ser.), 632:1-10

Beaufort, L.F. de, 1951 The fishes of the Indo-Australian Archipelago. 9. Percomorphi (concluded), Blennoidea. Leiden, Brill, 484 p.

Beaumariage, D.S., 1973 Age, growth and reproduction of king mackerel, Scomberomorus cavalla, in Florida. Fla.Mar. Res.Publ., (1):45 p.

Beebe, W. & G. Hollister, 1935 The fishes of the Union Island, Grenadines, British West Indies, with the description of a new species of star-gazer. Zoologica, N.Y., 19(6):209-24

Beebe, W. & J. Tee-Van, 1936 Systematic notes on Bermudian and West Indian tunas of the genera Parathunnus and Neothunnus. Zoologica, N.Y., 21(3):177-94

Bell, R.R., 1963 Synopsis of biological data on California bluefin tuna Thunnus saliens Jordan and Evermann, 1926. FAO Fish.Rep., (6) vol.2:380-421

Bellón, L. & E. Bardán de Bellón, 1949 Algunos datos sobre los "Thunnidae" de Canarias. Bol.Inst.Esp.Oceanogr., 19: 1-28

Bennett, E.T., 1831 Characters of new genera and species of fishes from the Atlantic coast of northern Africa, presented by Captain Belcher, R.N. Proc.Zool.Soc.Lond., (1830-1):145-8

Bernabei, H. (ed.), 1964 Proceedings of the World Scientific Meeting on the biology of tunas and related species. Actes de la réunion scientifique mondiale sur la biologie du thon et des espèces voisines. Actas de la reunión científica mundial sobre biología del atún y especies afines. Vol. 4. Bibliography. Bibliographie. Bibliografía. FAO Fish.Rep., (6) vol.4:1853-2272

Berrien, P. & D. Finan, 1977 Biological and fisheries data on king mackerel, Scomberomorus cavalla (Cuvier). Tech.Ser. Rep.Sandy Hook Lab., (8):40 p.

_____, 1977a Biological and fisheries data on Spanish mackerel, Scomberomorus maculatus (Mitchill). Tech.Ser. Rep.Sandy Hook Lab., (9):52 p.

Bini, G., 1968 Atlante dei pesci delle coste italiane. Osteitti. Milano, Mondo Sommerso, vol. 6:177 p.

Bleeker, P., 1851 Visschen van Banka. Natuurk.Tijdschr.Ned.-Indie, 1:159-61

_____, 1851a Over eenige nieuwe geslachten en soorten van makreelachtige visschen van der Indischen Archipel. Natuurk.Tijdschr.Ned.-Indie, 1:341-72

_____, 1854 Faunae ichthyologicae japonicae species novae. Natuurk.Tijdschr.Ned.-Indie, 6:395-426

_____, 1855 Vijfde bijdrage tot de kennis der ichthyologische fauna van Ternate. Natuurk.Tijdschr.Ned.-Indie, 8:295-304

_____, 1856 Beschrijvingen van nieuwe en weinig bekende vischsoorten van Amboina, verzameld op eene reis door den Molukschen Archipel gedaan in het gevolg van den Gouverneur-Generaal Duymaer van Twist, in September en October 1855. Acta Soc.Sci.Indo-Neerl., 1:1-72

Bloch, M.E., 1793 Naturgeschichte der ausländischen Fische. Berlin, Königliche Akademia für Kunst, Pt. 7:144 p.

Bloch, M.E. & J.G. Schneider, 1801 Systema ichthyologiae, iconibus ex illustratum. Berolini, 584 p.

Bonaparte, C.L., 1831 Saggio d'una distribuzione metodica degli animali vertebrati a sangue freddo. G.Acad.Sci.Lett. Art, Roma, 53:129-209

_____, 1845 Catalogo metodico dei pesci Europei. Atti Sci.Ital., 1845:1-95

Bonnaterre, J.P., 1788 Tableau encyclopédique et methodique des trois regnes de la nature. Ichthyologie. Paris, 215 p.

Brünnich, M.Th., 1768 Ichthyologia Massiliensis, sistens piscium descriptiones eorumque apud incolas nomina. Accedunt Spolia Maris Adriatici. Hafnea et Lipsiae, 110 p.

Calkins, T.P., 1980 Synopsis of biological data on the bigeye tuna, Thunnus obesus (Lowe, 1839), in the Pacific Ocean. Spec.Rep.I-ATTC, (2):213-59

Calkins, T.P. & W.L. Klawe, 1963 Synopsis of biological data on black skipjack Euthynnus lineatus Kishinouye, 1920. FAO Fish.Rep., (6) vol.2:130-46

Cantor, T.E., 1849 Catalogue of Malayan fishes. J.Asiatic Soc.Bengal, 18(2):983-1443

Carey, F.G., et al., 1971 Warm-bodied fish. Am.Zool., 11:135-43

Carus, J.V., 1893 Prodromus faunae Mediterraneae. Vertebrata. 1. Class.Pisces. Stuttgart, E. Schweizerbart'sche, vol.2:498-711

Castelnau, F.L., Contribution to the ichthyology of Australia. Proc.Zool.Acclim.Soc.Vict., 1:29-247
1872

Chabanaud, P., Sur quelques Scombroides de la côte occidentale d'Afrique. Bul.Soc.Zool.Fr., 50:197-201
1925

Chabanaud, P. & T. Monod, Les poissons de Port-Etienne. Bull.Com.Etud.Hist.Sci.Afr.Occident.Fr., 1926:225-87
1927

Chacko, P.I., S.D. Thomas & C.M. Pillay, Scombroid fisheries of Madras State, India. Symp.Ser.Mar.Biol.Assoc.
1968 India, 1(3):1006-8

Chanxil, Liu, Zhang Xu & Yang Kaiwen, Studies on the growth of Spanish mackerel, Scomberomorus niphonius in
1982 the Huanghai Sea and Bohai Sea. Oceanol.Limnol.Sinica, 8(2):178-91 (in Chinese, English Summary)

Chevey, P., Révision synonymique de l'Oeuvre ichtyologique de G. Tirant. Notes Stn.Marit.Cauda, (7):291 p.
1934

Chirinos de Vildoso, A., Especies del género Sarda en el Pacífico oriental. FAO Fish.Rep., (6) vol.3:1549-56
1934

Clarke, W.E., Occurrence of the long-finned tunny off the Orkney Islands. Ann.Scott.Nat.Hist., 1900:248
1900

Cole, J.S., Synopsis of biological data on the yellowfin tuna, Thunnus albacares (Bonnaterre, 1788), in the Pacific
1980 Ocean. Spec.Rep.I-ATTC, (2):71-150

Collett, R., Meddelelser om Norges fiske i årene 1875-1878. Forh.Vidensk.Kristiania, (1):107 p.
1879

_____, Om den saakaldte Thynnus peregrinus, Coll., 1879. Forh.Vidensk.Kristiania, (15):3 p.
1879a

Collette, B.B., Revue critique des types de Scombridae des collections du Muséum national d'histoire naturelle de
1966 Paris. Bull.Mus.Natl.Hist.Nat.Paris (2ème Sér.), 38(4):362-75

_____, Scombridae. In FAO Species identification sheets for fishery purposes. Western Central Atlantic
1978 (Fishing Area 31), edited by W. Fischer. FAO, Rome, vol.4:34 p.

_____, Adaptations and systematics of the mackerels and tunas. In The physiological ecology of tunas,
1979 edited by G.D. Sharp and A.E. Dizon. New York, Academic Press, pp. 7-39

_____, Scombridae. In FAO Species identification sheets for fishery purposes. Eastern Central Atlantic,
1981 Fishing Areas 34,47 (in part), edited by W. Fischer, G. Bianchi & W.B. Scott. Ottawa, Department of Fisheries and Oceans Canada by arrangement with the Food and Agriculture Organization of the United Nations, vol.3:32 p.

_____, There are two species of double-lined mackerels (Grammatorcynus: Scombridae). Proc.Biol.Soc.
in press Wash., 96(4)

Collette, B.B. & L.N. Chao, Systematics and morphology of the bonitos (Sarda) and their relatives (Scombridae,
1975 Sardini). Fish.Bull.NOAA/NMFS, 73(3):516-625

Collette, B.B. & J.L. Russo, An introduction to the Spanish mackerels, genus Scomberomorus. In Proceedings of
1979 Colloquium on the Spanish and King Mackerel Resources of the Gulf of Mexico, edited by E.L. Nakamura & H.R. Bullis, Jr. Publ.Gulf States Mar.Fish.Comm., (4):3-16

_____, Scomberomorus munroi, a new species of Spanish mackerel from Australia and New Guinea.
1980 Aust.J.Mar.Freshwat.Res., 31:241-50

Collette, B.B., J.L. Russo & L.A. Zavala-Camin, Scomberomorus brasiliensis, a new species of Spanish mackerel
1978 from the western Atlantic. Fish.Bull.NOAA/NMFS, 76(1):273-80

Collette, B.B. & B.R. Smith, Bluefin tuna, Thunnus thynnus orientalis, from the Gulf of Papua. Jap.J.Ichthyol.,
1981 28(2):166-8

Collignon, J., Le thazard ou melva dans l'Atlantique oriental. Bull.Inst.Pêche Marit.Maroc, 7:55-72
1961

Collins, R.A. & A. MacCall, California's Pacific bonito resource, its status and management. Mar.Resour.Tech.
1977 Rep.Calif.Dep.Fish Game, (35):39 p.

Cooper, A., 1982 A preliminary study of the fishery for cero mackerel (Scomberomorus regalis, Bloch), in Jamaican waters. Proc.Gulf Caribb.Fish.Inst., 34:149-55

Cooper, J.G., 1863 On new genera and species of California fishes. 1. Proc.Calif.Acad.Sci., 3(1):70-7

Corwin, G., 1930 A bibliography of the tunas. Fish.Bull.Calif.Fish Game, 22:1-103

Costa, R. Saraiva da & M. Pinto Paiva, 1969 Notas sôbre a pesca da cavala e da serra no Ceará - dados de 1968. Arq.Ciênc.Mar, Fortaleza, 9(1):89-95

Couch, J., 1832 Fishes new to the British fauna, contained in Couch's "History of the fishes of Cornwall". Mag.Nat.Hist., 5:15-24

_____, 1863 The history of the fishes of the British Isles. London, Groombridge and Sons, vol.2:265 p.

Cuvier, G., 1817 Le règne animal distribué d'aprés son organisation, pour servir de base a l'histoire naturelle des animaux et d'introduction à l'anatomie comparée. Vol. 2. Les reptiles, les poissons, les mollusques, et les annélides. Paris, 532 p.

_____, 1829 Le règne animal distribué d'après son organisation, pour servir de base à l'histoire naturelle des animaux et d'introduction à l'anatomie comparée. Vol. 2. Poissons. Paris, vol.2:406 p. 2nd ed.

Cuvier, G. & A. Valenciennes, 1831 Histoire naturelle des poissons. Paris, G.F. Levrault, vol.8:375 p.

David, L.R., 1943 Miocene fishes of southern California. Spec.Publ.Geol.Soc.Am., (43):193 p.

Davidoff, E.B., 1963 Size and year class composition of catch, age and growth of yellowfin tuna in the eastern tropical Pacific Ocean, 1951-1961. Bull.I-ATTC, 8(4):200-51

Day, F., 1870 On the fishes of the Andaman Islands. Proc.Zool.Soc.Lond., (1870):677-705

De Buen, F., 1930 Ictiología española. 1. Scombriformes y Thunniformes. Bol.Oceanogr.Pesca, Madr., 15(162):34-53

_____, 1930a Estados larvarios y juveniles de la Sarda sarda (Bloch). Trab.Inst.Esp.Oceanogr., (3):32 p.

_____, 1958 Peces del suborden Scombroidei en aguas de Chile. Rev.Biol.Mar., Chile, 7(1-3):3-38

Delaroche, F.E., 1809 Suite du mémoire sur les espèces de poissons observées a Iviça. Ann.Mus.Hist.Nat., Paris, 13: 313-61

Demir, M., 1963 Synopsis of biological data on bonito Sarda sarda. FAO Fish.Rep., (6) vol.2:101-29

De Sylva, D.P., 1955 The osteology and phylogenetic relationships of the blackfin tuna, Thunnus atlanticus (Lesson). Bull.Mar.Sci.Gulf Caribb., 5(1):1-41

De Sylva, D.P. & W.F. Rathjen, 1961 Life history notes on the little tuna, Euthynnus alletteratus, from the southeastern United States. Bull.Mar.Sci.Gulf Caribb., 11(2):161-90

DeVane, J.C., Jr., 1978 Food of king mackerel, Scomberomorus cavalla, in Onslow Bay, North Carolina. Trans.Am.Fish.Soc., 107(4):583-6

Devaraj, M., 1976 Discovery of the scombrid Scomberomorus koreanus (Kishinouye) in India, with taxonomic discussion on the species. Jap.J.Ichthyol., 23(2):79-87

_____, 1977 Osteology and relationships of the Spanish mackerels and seerfishes of the tribe Scomberomorini. Indian J.Fish., 22(1-2):1-67

_____, 1982 Age and growth of the three species of seerfishes Scomberomorus commerson, S. guttatus and S. lineolatus. Indian J.Fish, 28(1-2):104-27

De Vis, 1884 New fishes in the Queensland Museum. Proc.Linn.Soc.New South Wales, 9(3):537-47

Döderlein, P., 1871 Descrizione di una notevole species di sgomberoide (Cybium verany Doderlein) presa nelle acque di Sicilia. G.Sci.Nat.Econ.Palermo, 8:125-30

Doi, T. & D. Mendizábal, 1979 Evaluación preliminar de la población de sierra, Scomberomorus maculatus (Mitchill), frente a las costas de Veracruz. In Proceedings of the Colloquium on the Spanish and King Mackerel Resources of the Gulf of Mexico, edited by E.L. Nakamura and H.R. Bullis Jr. Publ.Gulf States Mar.Fish.Comm., 4:43-55

Dotson, R.C., 1980 Fishing methods and equipment of the U.S. west coast albacore fleet. NOAA Tech.Memo.NMFS, (NOAA-TM-NMFS-SWFC-8):126 p.

Dresslar, F.B. & B. Fesler, 1889 A review of the mackerels (Scombrinae) of America and Europe. Bull.U.S.Fish. Comm., 7(1887):429-46

Durand, J., 1940 Notes sur quelques poissons d'espèces nouvelles ou peu connues des eaux douces cambodgiennes. Notes Stn.Marit.Cauda, 36:1-40

Earll, R.E., 1883 The Spanish mackerel, Cybium maculatum (Mitchell). Age, its natural history and artificial propagation, with an account of the origin and development of the fishery. Rep.U.S.Comm.Fish Fish., 1880:395-426

Eckles, H.H., 1949 Observations on juvenile oceanic skipjack (Katsuwonus pelamis) from Hawaiian waters and sierra mackerel (Scomberomorus sierra) from the eastern Pacific. Fish.Bull.U.S.Fish Wildl.Serv., 51:245-50

Ehrenbaum, E., 1924 Scombriformes. Rep.Dan.Oceanogr.Exped.Mediterr.1908-1910, 2(11):42 p.

Erdman, D.S., 1977 Spawning patterns of fish from the northeastern Caribbean. FAO Fish.Rep., (200):145-69

Etchevers, S.L., 1976 Incidencia de clupeoideos en la alimentacion de las cabañas: Euthynnus alletteratus (Rafinesque) y Auxis thazard (Lacepède) en la costa noreste de Margarita. Lagena, (37-38):9-11

Evermann, B.W. & A. Seale, 1907 Fishes of the Philippine Islands. Bull.Bur.Fish.U.S., 26:49-110

Fagade, S.O. & C.I.O. Olaniyan, 1973 The food and feeding interrelationship of the fishes in the Lagos Lagoon. J.Fish Biol., 5(2):205-25

FAO, 1979 Yearbook of fishery statistics. Annuaire statistique des pêches. Anuario estadístico de pesca. Catches and landings. Captures et quantités débarquées. Capturas y desembarques, 1978. Yearb.Fish.Stat/ Annu.Stat.Pêches/Anu.Estad.Pesca, (46):372 p.

FAO, 1981 Yearbook of fishery statistics. Annuaire statistique des pêches. Anuario estadístico de pesca. Catches and landings. Captures et quantités débarquées. Capturas y desembarques, 1980. Year.Fish.Stat./ Annu.Stat.Pêches/Anu.Estad.Pesca, (50):386 p.

FAO, 1983 Yearbook of fishery statistics. Annuaire statistique des pêches. Anuario estadístico de pesca. Catches and landings. Captures et quantités débarquées. Capturas y desembarques, 1981. Yearb.Fish.Stat./ Annu.Stat.Pêches/Anu.Estad.Pesca, (52):356 p.

Farragut, R.N., 1972 Effects of some antioxidants and EDTA on the development of rancidity in Spanish mackerel (Scomberomorus maculatus) during frozen storage. NOAA Tech.Rep.NMFS (Spec.Sci.Rep.-Fish. Ser.), (650):12 p.

Farrugio, H., 1980 Age et croissance du thon rouge (Thunnus thynnus) dans la pêcherie française de surface en Méditerranée. Cybium (3ème Sér.), 1980(9):45-59

Finucane, J.H. & L.A. Collins, in prep. Reproductive biology of cero, Scomberomorus regalis, from the coastal waters of south Florida. MS

Fischer, W. (ed.), 1973 FAO species identification sheets for fishery purposes. Mediterranean and Black Sea (fishing area 37). Rome, FAO, 2 vols:pag.var.

Fischer, W. & P.J.P. Whitehead (eds), 1974 FAO species identification sheets for fishery purposes. Eastern Indian Ocean (fishing area 57) and Western Central Pacific (fishing area 71). Rome, FAO, vols 1-4:pag.var.

Fitch, J.E. & W.L. Craig, 1964 First records for the bigeye thresher (Alopias superciliosus) and slender tuna (Allothunnus fallai) from California, with notes on eastern Pacific scombrid otoliths. Calif.Fish Game, 50(3):195-206

Fitch, J.E. & A.O. Flechsig, 1949 A brief account of the Monterey Spanish mackerel (Scomberomorus concolor). Calif.Fish Game, 35(4):275-80

Fitch, J.E. & P.M. Roedel, 1963 A review of the frigate mackerels (genus Auxis) of the world. FAO Fish.Rep., (6) vol. 3:1329-42

Fonteles Filho, A.A., 1968 Sôbre a captura e abundância da cavala e da serra nos pesqueiros do Estado do Ceará. Arq.Estos.Mar.Univ.Ceará, 8(2):133-7

Foreman, T.J., 1980 Synopsis of biological data on the albacore tuna, Thunnus alalunga (Bonnaterre, 1788), in the Pacific Ocean. Spec.Rep.I-ATTC, (2):17-70

Forsbergh, E.D., 1980 Synopsis of biological data on the skipjack tuna, Katsuwonus pelamis (Linnaeus, 1758), in the Pacific Ocean. Spec.Rep.I-ATTC, (2):295-360

Fourmanoir, P., 1966 Nouvelle dénomination proposée pour un Scombridae du canal de Mozambique: Scomberomorus plurilineatus nov.sp. Bull.Mus.Hist.Nat., Paris, 38(3):223-6

Fowler, H.W., 1905 New, rare or little known scombroids. 1. Proc.Acad.Nat.Sci.Philad., 56:757-71

_____, 1933 Description of a new long-finned tuna (Semathunnus guildi) from Tahiti. Proc.Acad.Nat.Sci. Philad., 85:163-4

_____, 1934 The buckler dory and descriptions of three new fishes from off New Jersey and Florida. Proc.Acad.Nat.Sci.Philad., 86:353-61

_____, 1935 South African fishes received from Mr H.W. Bell-Marley. Proc.Acad.Nat.Sci.Philad., 87:361-408

_____, 1936 The marine fishes of West Africa. Bull.Am.Mus.Nat.Hist., 70(2):607-1493

Frade, F. & E. Postel, 1955 Contribution à l'étude de la reproduction des scombridés et thonidés de l'Atlantique tropical. Rapp.P.-V.Réun.CIEM, 137:33-5

Fraser-Brunner, A., 1949 On the fishes of the genus Euthynnus. Ann.Mag.Nat.Hist., 12(2):622-7

_____, 1950 The fishes of the family Scombridae. Ann.Mag.Nat.Hist., 12 (3):131-63

Geoffroy Saint-Hilaire, E., 1817 Poissons du Nil de la mer Rouge et de la Méditerranée. In Description de l'Egypte ... Histoire naturelle, Paris, vol. 1, Pt. 1:18-27

Geoffroy Saint-Hilaire, I., 1827 Histoire naturelle des poissons de la mer Rouge et de la Méditerranée. In Description de l'Egypte... Histoire naturelle, Paris, vol. 1, Pt. 1:311-40

Gesteira Vasconcelos, T.C., 1972 Sôbre a reprodução e fecundidade da serra, Scomberomorus maculatus (Mitchill), no Estado do Ceará. Arq.Ciênc.Mar, Fortaleza, 12(2):117-22

Gibbs, R.H., Jr. & B.B. Collette, 1967 Comparative anatomy and systematics of the tunas, genus Thunnus. Fish.Bull.U.S.Fish.Wildl.Serv., 66:65-130

Giglioli, E.H., 1880 Elenco dei mammiferi, degli uccelli e dei rettili ittiofagi appartenenti alla fauna italica e catalogo degli anfibi e dei pesci italiani. Firenze, Stamperia reale, 55 p.

Gill, T.N., 1862 On the limits and arrangement of the family of scombroids. Proc.Acad.Nat.Sci.Philad., 1814:124-7

Ginsburg, I., 1953 The taxonomic status and nomenclature of some Atlantic and Pacific populations of yellowfin and bluefin tunas. Copeia, (1):1-10

Girard, C., 1859 Fishes. In Reports of explorations and surveys to survey the most practical and economical route for a railroad from the Mississippi River to the Pacific Ocean. Vol. 10.

Gmelin, J.F., 1789 Caroli a Linné...Systema naturae. Vol. 1, Pt. 3, Pisces Lipsiae, pp. 1126-516

Godsil, H.C., 1954 A descriptive study of certain tuna-like fishes. Fish Bull.Calif.Dep.Fish. Game, (97):188 p.

Graham, J.B., 1973 Heat exchange in the black skipjack and the blood-gas relationship of warm-bodied fishes. Proc.Natl.Acad.Sci.USA, 70(7):1964-7

_____, 1975 Heat exchange in the yellowfin tuna, Thunnus albacares, and skipjack tuna, Katsuwonus pelamis, and the adaptive significance of elevated body temperatures in scombrid fishes. Fish.Bull.NOAA/NMFS, 73:219-29

Grant, E.M., 1978 Guide to fishes. Brisbane, Department of Harbours and Marine, 768 p., 4th ed.

_____, 1982 Guide to fishes. Brisbane, Department of Harbours and Marine, 896 p., 5th ed.

Günther, A., 1860 Catalogue of the acanthopterygian fishes in the collection of the British Museum. London, Taylor and Francis, Ltd., vol.2:548 p.

_____, 1873 On a collection of fishes from Chefoo, North China. Ann.Mag.Nat.Hist.(Ser.4), 12:377-80

_____, 1889 Report on the pelagic fishes collected by H.M.S. Challenger during the years 1873-76. Rep.Sci.Result.Voyage H.M.S. Challenger (Zool.), 31(2):1-47

Habib, G., I.T. Clement & K.A. Fisher, 1981 The 1980-81 purse-seine skipjack fishery in New Zealand waters. Occas.Publ.Fish.Res.Div.N.Z., (36):52 p.

Hale, M.B., 1979 Preservation technology for Spanish mackerel and related species - a literature review. In Proceedings of the Colloquium on the Spanish and King Mackerel Resources of the Gulf of Mexico, edited by E.L. Nakamura and H.R. Bullis, Jr. Publ.Gulf States Mar.Fish.Comm., (4):73-97

Hamada, T. & S. Iwai, 1967 Biological studies on sawara resources in Harima-Nada and adjacent waters. 1. On some morphological characters and growth. Bull.Jap.Soc.Sci.Fish., 33:1013-20 (in Japanese with English abstract)

Houttuyn, M., 1782 Beschryving van eenige Japansce visschen, en andere zee-schepzelen. Verh.Holl.Maatsch.Wet. Haarlem, 20(2):311-50

Hunter, J.R. & C. Kimbrell, 1980 Early life history of Pacific mackerel Scomber japonicus. Fish.Bull.NOAA/NMFS, 78:89-101

I-ATTC/CIAT, 1978 Annual report of the Inter-American Tropical Tuna Commission. Informe anual de la Comisión Interamericana del Atún Tropical. Annu.Rep.I-ATTC/Inf.Anu.CIAT, (1977):155 p.

Idyll, C.P. & D. de Sylva, 1963 Synopsis of biological data on the blackfin tuna Thunnus atlanticus (Lesson) 1830 (Western Atlantic). FAO Fish.Rep., (6) vol.2:761-70

Iversen, E.S. & H.O. Yoshida, 1957 Notes on the biology of the wahoo in the Line Islands. Pac.Sci., 11(4):370-9

Ivo, C.T.C., 1972 Epoca de desova e idade na primeira naturação sexual da cavala, Scomberomorus cavalla (Cuvier) no Estado do Ceará. Arq.Ciênc.Mar, Fortaleza, 12(1):27-9

_____, 1974 Sôbre a fecundidade da cavalla, Scomberomorus cavalla (Cuvier), em águas costeiras do Estado do Ceará (Brasil). Arq.Ciênc.Mar, Fortaleza 14(2):87-9

James, G.D. & G. Habib, 1979 First record of Australian bonito, Sarda australis, from New Zealand. N.Z.J.Mar. Freshwat.Res., 13(3):425-6

Jones, S., 1963 Synopsis of biological data on the long corsetted frigate mackerel Auxis thynnoides Bleeker, 1855. FAO Fish.Rep., (6) vol.2:782-810

_____, 1963a Synopsis of biological data on the northern bluefin tuna Kishinoella tonggol (Bleeker) 1851 (Indian Ocean). FAO Fish.Rep., (6) vol.2:862-76

Jones, S., 1968 The scombroid fishery of India - present and future. Symp.Ser.Mar.Biol.Assoc.India, 1(3):994-1000

Jones, S. & H. Rosa, Jr., 1965 Synopsis of biological data on Indian mackerel Rastrelliger kanagurta (Cuvier) 1817, and short bodied mackerel Rastrelliger brachysoma (Bleeker) 1851. FAO Fish.Synop., (29):pag.var.

Jones, S. & H. Rosa, Jr., 1967 Synopsis of biological data on the fishes of the genus Rastrelliger Jordan & Starks, 1908 with an annotated bibliography. Symp.Ser.Mar.Biol.Assoc.India, 1(3):1190-236

Jones, S. & E.G. Silas, 1961 Indian tunas - a preliminary review, with a key for their identification. Indian J.Fish., 7(2):369-93

_____, 1963 Synopsis of biological data on skipjack Katsuwonus pelamis (Linnaeus) 1758 (Indian Ocean). FAO Fish.Rep., (6) vol.2:663-94

_____, 1963a Tuna and tuna-like fishes from the Indian seas. FAO Fish.Rep., (6) vol.3:1775-96

_____, 1964 A systematic review of the scombroid fishes of India. Symp.Ser.Mar.Biol.Assoc.India, 1(1):1-105

_____, 1964a Mackerel from the Andaman Sea. Symp.Ser.Mar.Biol.Assoc.India, 1(1):255-82

Jordan, D.S., 1888 On the generic name of the tunny. Proc.Acad.Nat.Sci.Philad., (1888):180

_____, 1895 The fishes of Sinaloa. Proc.Calif.Acad.Sci., 5:378-514

Jordan, D.S. & M.C. Dickerson, 1908 On a collection of fishes from Fiji, with notes on certain Hawaiian fishes. Proc.U.S.Natl.Mus., 34:603-17

Jordan, D.S. & B.W. Evermann, 1896 The fishes of North and Middle America. Bull.U.S.Natl.Mus., 47(1):1240 p.

_____, 1926 A review of the giant mackerel-like fishes, tunnies, spearfishes and swordfishes. Occas.Pap. Calif.Acad.Sci., (12):1-113

Jordan, D.S. & C.H. Gilbert, 1882 Synopsis of the fishes of North America. Bull.U.S.Natl.Mus., 16:1018 p.

Jordan, D.S. & C.L. Hubbs, 1925 Record of fishes obtained by David Starr Jordan in Japan, 1922. Mem.Carnegie Mus., 10(2):93-346

Jordan, D.S. & A. Seale, 1909 The fishes of Samoa. Bull.U.S.Bur.Fish., 25:173-455

Jordan, D.S. & J.O. Snyder, 1900 A list of fishes collected in Japan by Keinosuke Otaki, and by the United States steamer ALBATROSS, with description of fourteen new species. Proc.U.S.Natl.Mus., 23(1213):335-80

_____, 1901 A preliminary check list of the fishes of Japan. Annot.Zool.Jap., 3(2-3):31-159

Jordan D.S., S. Tanaka & J.O. Snyder, 1913 A catalogue of the fishes of Japan. J.Coll.Sci.Imp.Univ., Tokyo, 33(1): 1-497

Joseph, J., 1963 The fecundity of yellowfin tuna (Thunnus albacares) and skipjack (Katsuwonus pelamis) from the eastern Pacific Ocean. Bull.I-ATTC, 7(4):255-92

Kaikini, A.S., 1961 The fisheries of Malwan. Indian J.Fish., 7(2):348-68

Kampen, P.N. van, 1907 Über zwei Scomber-Arten des Indischen Archipels. Meded.Afd.Landb.Dep.Landb.Ned.-India, Buitenzorg, (8):8 p.

Kearney, R.E. & M.L. Rivkin, 1981 An examination of the feasibility of baitfish culture for skipjack pole-and-line fishing in the South Pacific Commission area. Skipjack Surv.Assess.Programme Tech.Rep., Noumea, (4):23 p.

Kikawa, S., et al., 1963 Synopsis on the biology of little tuna Euthynnus yaito Kishinouye 1923. FAO Fish.Rep., (6) vol.2:218-40

_____, 1963a Synopsis of biological data on bonito Sarda orientalis Temminck and Schlegel, 1842. FAO Fish.Rep., (6) vol.2:147-56

Kim, Wan Soo, 1970 Studies on the Spanish mackerel populations. 1. Age determination. J.Oceanol.Soc.Korea, (1): 37-40 (in Korean with English abstract)

Kishinouye, K., 1915 A study of the mackerels, cybiids, and tunas. Suisan Gakkai Ho, 1(1):1-24 (transl. by W.F. Van Campen, POFI 1949)

_____, 1920 Mexican little tunny. Suisan Gakkai Ho, 3(2):113

_____, 1923 Contributions to the comparative study of the so-called scombroid fishes. J.Coll.Agric.Imp. Univ.Tokyo, 8(3):293-475

Kitahara, T., 1897 Scombridae of Japan. J.Imp.Fish.Bur., Tokyo, 6:15 p. (in Japanese with English summary)

Klawe, W.L., 1966 Notes on occurrence of young and spawning of Scomberomorus sierra in the Eastern Pacific Ocean. Pac.Sci., 20(4):445-51

_____, 1977 What is a tuna? Mar.Fish.Rev., 39(11):1-5

_____, 1980 Classification of the tunas, mackerels, billfishes, and related species, and their geographical distribution. Spec.Rep.I-ATTC, (2):5-16

Klima, E.F., 1959 Aspects of the biology and the fishery for Spanish mackerel, Scomberomorus maculatus (Mitchill), of southern Florida. Tech.Ser.Mar.Lab.Univ.Miami, (27):39 p.

Kong, I., 1978 Scomberomorus maculatus (Mitchill) 1815 en Antofagasta, Chile. Not.Mens.Mus.Nac.Hist.Nat., Chile, 22(262):6-9

Kramer, D., 1969 Synopsis of the biological data on the Pacific mackerel Scomber japonicus Houttuyn (Northeast Pacific). Circ.USFWS, (302):18 p. Issued also as FAO Fish.Synop., (40):18 p.

Krishnamoorthi, B., 1957 Fishery resources of the Rameswaram Island. Indian J.Fish., 4(2):229-53

_____, 1958 Observations on the spawning season and the fisheries of the spotted seer, Scomberomorus guttatus (Bloch and Schneider). Indian J.Fish., 5(2):270-81

Kuramaran, M., 1964 Observations on the food of juveniles of Scomberomorus commerson (Lacepède) and S. guttatus (Bloch and Schneider) from Vizhingam, west coast of India. Symp.Ser.Mar.Biol.Assoc.India, 1(2):586-90.

Kume, S., 1967 Distribution and migration of bigeye tuna in the Pacific Ocean. Rep.Nankai Reg.Fish.Res.Lab., (25):75-80

Kuo, Ching-ming, 1970 Taxonomic, growth, and maturation studies on the bonitos of the temperate eastern Pacific Ocean. Ph.D. Thesis, University of California, San Diego, 321 p. Diss.Abstr.Int., 31B:2805-6

Lacepède, B., 1800-1803 Le scombre thon (Scomber thynnus). In Histoire naturelle des poissons. Paris, Plasson, vol.2:605-32

Lahille, F., 1903 Nota sobre un género nuevo de escómbrido. An.Mus.Nac.B.Aires (Ser. 3), 2:375-6

_____, 1905 Nota sobre el Chenogaster holmbergi. An.Mus.Nac.B.Aires (Ser. 3), 4:461-76

Lay, G.T. & E.T. Bennett, 1839 Fishes. In The zoology of Captain Beechey's voyage. London, Henry G. Bohn, pp. 41-75

Le Danois, E., 1954 Résumé de nos connaissances actuelles sur l'albacore ou yellow fin tuna (Thunnus albacores Bonnaterre). Bull.Inst.Fr.Afr.Noire (A Sci.Nat.), 16(1):283-94

Le Gall, J.-Y., 1974 Exposé synoptique des données biologiques sur le germon Thunnus alalunga (Bonnaterre, 1788) de l'océan Atlantique. FAO, Synop.Pêches, (109):70 p.

Le Gall, J.-Y., 1981 Bibliographie annotée du germon, Thunnus alalunga (Bonnaterre, 1788) de l'océan Atlantique, 1973-1980. Annotated bibliography on albacore Thunnus alalunga (Bonnaterre, 1788) of the Atlantic Ocean, 1973-1980. Bibliografía anotada sobre el atún blanco (albacora) Thunnus alalunga (Bonnaterre, 1788) del Océano Atlántico. FAO Rapp.Pêches/FAO Fish.Rep./FAO Inf.Pesca, (6) vol.4, Suppl./Suppl./Supl. 2:80 p.

Lesson, R.P., 1822 Zoologie. Poissons. In Voyage autour du monde-sur la corvette ... LA COQUILLE pendant 1822-25, by L.I. Duperrey. Paris, vol. 2, Pt. 1:86-238

_____, 1829 Scombre. In Dictionnaire classique d'histoire naturelle, by J.B. Bory de St. Vincent. Paris, vol.15:276-80

Lewis, A.D., 1981 Population genetics, ecology and systematics of Indo-Australian scombrid fishes, with particular reference to skipjack tuna (Katsuwonus pelamis). Canberra, Australian National University, Ph.D. Thesis

Lewis, A.D., L.B. Chapman & A. Sesewa, 1983 Biological notes on coastal pelagic fishes in Fiji. Tech.Rep.Fish.Div., Fiji, (4)

Lewis, A.D., B.R. Smith & R.E. Kearney, 1974 Studies on tunas and baitfish in Papua New Guinea waters. 2. Res.Bull.Dep.Agric.Stock Fish.Papua New Guinea, (11):113 p.

Lewis, R.J. & R. Endean, 1983 Occurrence of a ciguatoxin-like substance in the Spanish mackerel (Scomberomorus commersoni). Toxicon, 21(1):19-24

Lindberg, G.U., A.S. Heard & T.S. Rass, 1980 Multilingual dictionary of names of marine food-fishes. Leningrad, "Nauka" Leningradskoe Ototelenie, 558 p. (in Russian, English, French, German, Spanish, Chinese)

Linnaeus, C., 1758 Systema naturae. Vol. 1. Regnum animale. Holmiae, 10th ed. Issued also by the British Museum (Natural History), London, 823 p. (1956) (Lithoprint)

Liu, Chanxin, Xu Zhang & Kaiwen Yang, 1982 Studies on the growth of Spanish mackerel, Scomberomorus niphonius in the Huanghai Sea and Bohai Sea. Oceanol.Limnol.Sinica, 13(2):170-8 (in Chinese with English abstract)

Lockington, W.N., 1879 On a new genus and species of Scombridae. Proc.Acad.Nat.Sci.Philad., 31:133-6

López, R.B., 1955 La caballa del mar argentino. Datos sobre su biología y pesca. Rev.Asoc.Argent.Dietol., 13:25-33

Lowe, R.H., 1962 The fishes of the British Guiana continental shelf, Atlantic coast of South America, with notes on their natural history. J.Linn.Soc.Lond.(Zool.), 44(301):669-700

Lowe, R.T., 1839 A supplement to a synopsis of the fishes of Madeira. Proc.Zool.Soc. Lond., 7:76-92

Lütken, C., 1880 Spolia Atlantica. Bidrag til kundskab om formforandringer hos fiske under deres vaext og udvikling saerligt hos nogle af Atlanterhavets Hø jsø fiske. Dansk.Videnskapsselsk.Køben havn, 5(Ser.12): 409-613

Lyles, C.H., 1969 The Spanish mackerel and king mackerel fisheries. Commer.Fish.Stat.Wash., (4936):21 p.

Macleay, W., 1880 Descriptive catalogue of the fishes of Australia. Part 2. Proc.Linn.Soc.N.S.W., 5(4):510-629

_____, 1884 Notes on a collection of fishes from the Burdekin and Mary Rivers, Queensland. Proc.Linn.Soc. N.S.W., 8(2):199-213

Magnuson, J.J., 1978 Locomotion by scombrid fishes: hydromechanics, morphology, and behaviour. In Fish physiology, edited by W.S. Hoar and D.J. Randall. New York, Academic Press, vol.7:239-313

Mago Leccia, F., 1958 The comparative osteology of the scombroid fishes of the genus Scomberomorus from Florida. Bull.Mar.Sci.Gulf Caribb., 8(4):299-341

_____, 1970 Lista de los peces de Venezuela, incluyendo un estudio preliminar sobre la ictiogeografía del país. Caracas, Ministerio de Agricultura y Cría, Oficina Nacional de Pesca, 283 p.

Malpas, A.H., 1926 The marine biological survey of the littoral waters of Ceylon. Bull.Ceylon Fish., 2:13-165

Manacop, P.R., 1958 A preliminary systematic study of the Philippine chub mackerels, family Scombridae, genera Pneumatophorus and Rastrelliger. Philipp.J.Fish, 4(2):79-101

Manooch III, C.S., 1979 Recreational and commercial fisheries for king mackerel, Scomberomorus cavalla, in the South Atlantic Bight and Gulf of Mexico, USA. In Proceedings of the Colloquium on the Spanish and King Mackerel Resources of the Gulf of Mexico, edited by E.L. Nakamura and H.R. Bullis, Jr. Publ.Gulf States Mar.Fish.Comm., (4):33-41

Manooch III, C.S. & W.T. Hogarth, 1983 Stomach contents and giant prematodes from wahoo, Acanthocybium solanderi, collected along the south Atlantic and Gulf coasts of the United States. Bull.Mar.Sci., 33(2):227-38

Manooch III, C.S., E.L. Nakamura & A.B. Hall, 1978 Annotated bibliography of four Atlantic scombrids: Scomberomorus brasiliensis, S. cavalla, S. maculatus, and S. regalis. NOAA Tech.Rep.NMFS Circ., (418):166 p.

Marchal, E., 1963 Description des stades post-larvaires et juvéniles de quatre espèces de Scombridae de l'Atlantique tropico-oriental. Mém.Inst.Fondam.Afr.Noire, 68:201-40

_____, 1963a Exposé synoptique des données biologiques sur la thonine Euthynnus alletteratus (Rafinesque) 1810 (Atlantique Oriental et Méditerranée). FAO Fish.Rep., (6) vol.2:647-62

Marine Biological Association of India, 1964 Proceedings of the Symposium on scombroid fishes, held at Mandapam Camp from January 12-15, 1962. Part 1. Symp.Ser.Mar.Biol.Assoc.India, 1(1):564 p.

_____, 1964a Proceedings of the Symposium on scombroid fishes, held at Mandapam Camp from January 12-15, 1962. Part 2. Symp.Ser.Mar.Biol.Assoc.India, 1(2):565-798

_____, 1967 Proceedings of the Symposium on scombroid fishes, held at Mandapam Camp from January 12-15, 1962. Part 3. Symp.Ser.Mar.Biol.Assoc.India, 1(3):799-1236

_____, 1969 Proceedings of the Symposium on scombroid fishes, held at Mandapam Camp from January 12-15, 1962. Part 4. Symp.Ser.Mar.Biol.Assoc.India, 1(4):39 p.

Márquez M., R., 1974 Informe sinóptico de la sierra, Scomberomorus maculatus (Mitchill), del Golfo de México. Ser.Inf.Inst.Nac.Pesca, Mex., (114):19 p.

Mather III, F.J., 1954 Northerly occurrences of warmwater fishes in the western Atlantic. Copeia, 1954(4):292-3

Matsui, T., 1967 Review of the mackerel genera Scomber and Rastrelliger with description of a new species of Rastrelliger. Copeia, 1967(1):71-83

Matsumoto, W.M., 1974 The skipjack tuna, Katsuwonus pelamis an underutilized resource. Mar.Fish.Rev., 36(8):26-33

Matsumoto, W.M., R.A. Skillman & A.E. Dizon, in press Synopsis of biological data on skipjack tuna, Katsuwonus pelamis. NOAA Tech.Rep.NMFS Circ., to be issued also as FAO Fish.Synop., (136)

McCulloch, A.R., 1915 Notes on, and descriptions of Australian fishes. Proc.Linn.Soc.N.S.W., 40:259-77

_____, 1929 A check-list of the fishes recorded from Australia. Mem.Aust.Mus., 5(1):1-144

McCulloch, A.R. & G.P. Whitley, 1925 A list of the fishes recorded from Queensland waters. Mem.Queensl.Mus., 8(2):125-82

McEachran, J.D., J.H. Finucane & L.S. Hall, 1980 Distribution, seasonality and abundance of king and Spanish mackerel larvae in the northwestern Gulf of Mexico (Pisces: Scombridae). Northeast Gulf Sci., 4(1):1-16

McPherson, G.R., 1981 Preliminary report: Investigations of Spanish mackerel Scomberomorus commerson in Queensland waters. In Northern pelagic fish seminar, edited by C.J. Grant and D.G. Walter. Canberra, Australian Government Publication Service, pp. 50-8

Meek, S.E. & S.F. Hildebrand, 1923 The marine fishes of Panama. Publ.Field Mus.Nat.Hist.(Zool.Ser.), 15(1):330 p.

Meek, S.E. & R.G. Newland, 1884 A review of the American species of Scomberomorus. Proc.Acad.Nat.Sci.Philad., 1884:232-9

Menezes, M. Ferreira de, Alimentação da cavala, Scomberomorus cavalla (Cuvier), em águas costeiras do Estado
1969 do Ceará. Arq.Ciênc.Mar, Fortaleza, 9(1):15-20

_____, Alimentação da serra, Scomberomorus maculatus (Mitchill), em águas costeiras do Estado do
1970 Ceará. Arq.Ciênc.Mar, Fortaleza, 10(2):171-6

Menezes, M. Ferreira de & L. Pessoa Aragão, Aspectos da biometria e biologia do bonito, Euthynnus alletteratus
1980 (Rafinesque), do Estado do Ceará, Brasil. Arq.Ciênc.Mar, Fortaleza, 17(2):95-100

Merçeron, M., Note sur les tazars (Scomberomorus spp.) des côtes cambodgiennes et leur pêche. Trav.Fac.Sci.
1970 Univ.Rennes (Sér.Océanogr.Biol.), 3:69-90

Merrett, N.R. & C.H. Thorp, A revised key to the scombroid fishes of East Africa with new observations on their
1966 biology. Ann.Mag.Nat.Hist.(Ser. 13), 8:367-84

Mimura, K., et al., Synopsis of biological data on yellowfin tuna Neothunnus macropterus Temminck and Schlegel,
1963 1842 (Indian Ocean). FAO Fish.Rep., (6) vol.2:319-49

_____, Synopsis on the biology of bigeye tuna Parathunnus mebachi Kishinouye, 1923 (Indian Ocean). FAO
1963a Fish.Rep., (6) vol.2:350-79

Mitchill, S.L., The fishes of New York, described and arranged. Trans.Lit.Philos.Soc.N.Y., 1:355-492
1815

Mowbray, L.L., Description of a Thunnus believed to be new. Copeia, (78):9-10
1920

_____, Description of the Bermuda large-eyed tuna Parathunnus ambiguus, n. sp., Bermuda, May 1935.
1935 Bermuda, Government Aquarium, 3 p.

Muhlia-Melo, A.F., Synopsis of biological data on the black skipjack tuna, Euthynnus lineatus Kishinouye, 1920.
1980 Spec.Rep.I-ATTC, (2):361-94

Munro, I.S.R., The eggs and early larvae of the Australian barred Spanish mackerel, Scomberomorus commersoni
1942 (Lacepède) with preliminary notes on the spawning of that species. Proc.R.Soc.Queensl., 54(4):33-48

_____, Revision of Australian species of Scomberomorus. Mem.Queensl.Mus., 12(2):65-95
1943

_____, The marine and freshwater fishes of Ceylon. Department of External Affairs, Canberra, 349 p.
1955

_____, Additions to the fish fauna of New Guinea. Papua New Guinea Agric.J., 16(4):141-86
1964

Murakami, S. & T. Hayano, On the number of interneural spines of mackerels from Japanese waters.
1956 Bull.Jap.Soc.Sci.Fish., 21(9):1000-6 (in Japanese, summary in English)

Nakamura, H., The tunas and their fisheries. Spec.Sci.Rep.U.S.Fish Wildl.Serv.(Fish.), (82):115 p.
1952

Nakamura, I. & K. Mori, Morphological study on the slender tuna, Allothunnus fallai Serventy obtained from the
1966 Tasman Sea. Rep.Nankai Reg.Fish.Res.Lab., (23):67-83

Nakamura, I & R. Nakamura, New records of two species of Scomberomorus from Japan. Jap.J.Ichthyol.,
1982 28(4):445-9

Naughton, S.P. & C.H. Saloman, Stomach contents of juveniles of king mackerel (Scomberomorus cavalla) and
1981 Spanish mackerel (S. maculatus). Northeast Gulf Sci., 5(1):71-4

Nichols, J.T., Two new fishes from the Pacific Ocean. Novit.Am.Mus.Nat.Hist., (94):3 p.
1923

Nichols, J.T. & R.C. Murphy, On a collection of marine fishes from Peru. Bull.Am.Mus.Nat.Hist., 46(9):501-16
1922

NMFS, Southwest Fisheries Center, Honolulu Laboratory and the Far Seas Fisheries Research Laboratory of the
1980 Fisheries Agency of Japan, State of selected stocks of tuna and billfish in the Pacific and Indian oceans. Summary report of the Workshop on the assessment of selected tunas and billfish stocks in the Pacific and Indian oceans. Organized by the Honolulu Laboratory, Southwest Fisheries Center, NMFS and the Far Seas Fisheries Research Laboratory of the Fisheries Agency of Japan. Shimizu, Japan, 12-22 June 1979. FAO Fish.Tech.Pap., (200):89 p.

NMFS, Southwest Fisheries Center, 1981 Status reports on world tuna and billfish stocks. NOAA Tech.Memo.NMFS, (NOAA-TM-NMFS-SWFC-15):302 p.

Nomura, H., 1967 Dados biológicos sôbre a serra, Scomberomorus maculatus (Mitchill), das águas cearenses. Arq.Estaç.Biol.Mar.Univ.Ceará, Fortaleza, 7(1):29-39

Nomura, H. & J.F. da Cruz, 1967 On the length and weight of Thunnus atlanticus (Lesson) from northeastern Brazil. Arq.Estaç.Biol.Mar.Univ.Ceará, Fortaleza, 7(1):91-4

Nomura, H. & M.S. de Sousa Rodrigues, 1967 Biological notes on king mackerel, Scomberomorus cavalla (Cuvier), from northeastern Brazil. Arq.Estaç.Biol.Mar.Univ.Ceará, Fortaleza, 7(1):79-85

OECD, 1978 Multilingual dictionary of fish and fish products. Dictionnaire multilingue des poissons et produits de la pêche. Farnham, Surrey. Fishing News Books Ltd., 430 p., 2nd ed.

Olson, R.J., 1980 Synopsis of biological data on the southern bluefin tuna, Thunnus maccoyii (Castelnau, 1872). Spec.Rep.I-ATTC, (2):151-212

_____, 1982 Feeding and energetics studies of yellowfin tuna; food for ecological thought. Collect.Vol.Sci. Pap.ICCAT/Recl.Doc.Sci.CICTA/Colecc.Doc.Cient.CICAA, 17:444-57

Orsi, J.J., 1974 A check list of the marine and freshwater fishes of Vietnam. Publ.Seto Mar.Biol.Lab., 21(3/4):153-77

Padoa, E., 1956 Divisione: Scombriformes. In Monografia. Uova, larve e stadi giovanili di teleostei. Fauna Flora Golfo Napoli, 38:471-521. English translation by J.P. Wise and G.B. Ranallo issued as Transl.Bur. Commer.Fish.Trop.Atl.Lab., (12)

Paiva, M.P. & R.S. da Costa, 1966 Considerações sôbre a produção de pescado marinho salgado no Estado do Ceará. Bol.Estaç.Biol.Mar.Univ.Fed.Ceará, (15):11 p.

Pallas, P.S., 1811 Zoographia Rosso-Asiatica, sistens omnium animalium in extenso Imperio Rossico et adjacentibus maribus observatorum recensionem, domicilia, mores et descriptiones, anatomen atque icones plurimorum. Petropoli, vol. 3, 428 p.

Pathansali, D., 1968 Note on the scombroid fishery in Malaya. Symp.Ser.Mar.Biol.Assoc.India, 1(3):1001-5

Poey, F., 1860 Poissons de Cuba. Mem.Hist.Nat.Isla Cuba, 2(2):115-336

_____, 1868 Synopsis piscium cubensium. Repert.Fis.-Nat.Cuba, 2:279-484

_____, 1875 Enumeratio piscium cubensium. Part 1. An.Soc.Esp.Hist.Nat., Madr., 4:113-61

Postel, E., 1950 Note sur les thonidés de la Presqu'île du Cap Vert. Bull.Serv.Elev.Ind.Anim.Afr.Occident.Fr., 3(2-3):41-76

_____, 1955 Contribution à l'étude de la biologie de quelques Scombridae de l'Atlantique tropico-oriental. Ann.Stn.Océanogr.Salammbô, 10:167 p.

_____, 1956 Essai sur la Palomette Orcynopsis unicolor (Geoffroy Saint-Hilaire, 1809). Bull.Inst.Fondam.Afr. Noire (A Sci.Nat.), 18(4):1220-48

_____, 1963 Exposé synoptique des données biologiques sur la bonite à ventre rayé Katsuwonus pelamis (Linné) 1758 (Atlantique et Méditerranée). FAO Fish.Rep., (6) vol.2:515-37

_____, 1963a Exposé synoptique sur la biologie du germon Germo alalunga (Cetti) 1777 (Atlantique oriental). FAO Fish.Rep., (6) vol.2:931-75

_____, 1973 Scomberomoridae. In CLOFNAM, 1. Check-list of the fishes of the north-eastern Atlantic and of the Mediterranean. Catalogue des poissons de l'Atlantique du nord-est et de la Méditerranée, edited by J.C. Hureau and Th. Monod. Paris, Unesco, vol.1:473-5

Powell, D., 1975 Age, growth and reproduction in Florida stocks of Spanish mackerel Scomberomorus maculatus. Fla.Mar.Res.Publ., (5):21 p.

Prado, J., 1970 Notes sur Scomberomorus commerson Lacepède, 1800, de la côte nord-ouest de Madagascar. Trav.Fac.Sci.Univ.Rennes (Sér.Océanogr.Biol.), 3:91-116

Quoy, J.R. & P. Gaimard, Poissons. In Voyage autour du monde,...exécuté sur les corvettes de S.M. l'URANIE et
1824 LA PHYSICIENNE, pendant les années 1817-1820. Paris, vol. 3. Zoologie. Chapter 9, pp. 192-401

Rafinesque, C.S., Caratteri di alcuni nuovi generi e nuove specie di animali e piante della Sicilia, con varie osserva-
1810 zioni sopra i medesimi. Palermo, 105 p.

_____, Indice d'ittiologia siciliana; ossia, catalogo metodico dei nomi latini, italiani, e siciliani dei
1810a pesci, che si rinvengono in Sicilia disposti secondo un metodo naturale e seguito da un appendice che contiene la descrizione di alcuni nuovi pesci siciliani. Messina, Presso Giovanni del Nobolo, 70 p.

Rainer, S.F. & I.S.R. Munro, Demersal fish and cephalopod communities of an unexploited coastal environment in
1982 northern Australia. Aust.J.Mar.Freshwat.Res., 33:1039-55

Randall, J.E., Food habits of reef fishes of the West Indies. Stud.Trop.Oceanogr., 5:665-847
1967

_____, A survey of ciguatera at Enewetak and Bikini, Marshall Islands, with notes on the systematics and
1980 food habits of ciguatoxic fishes. Fish Bull.NOAA/NMFS, 78(2):201-49

Rao, K. Srinivasa, Observations on the food and feeding habits of Scomberomorus guttatus (Bloch and Schneider)
1964 and juveniles of S. lineolatus (Cuvier and Valenciennes) and S. commerson (Lacepède) from the Waltair coast. Symp.Ser.Mar.Biol.Assoc.India, 1(2):591-8

Richards, W.J. & W.L. Klawe, Indexed bibliography of the eggs and young of tunas and other scombrids (Pisces,
1972 Scombridae), 1880-1970. NOAA Tech.Rep.NMFS SSRF, (652):107 p.

Richardson, J., Generic characters of Gasterochisma melampus, a fish which inhabits Port Nicholson, New
1845 Zealand. Ann.Mag.Nat.Hist., 15:346

Risso, A., Ichthyologie de Nice, ou histoire naturelle des poissons du département des Alpes Maritimes. Paris, F.
1810 Schoell, 388 p.

_____, Histoire naturelle des poissons de la Méditerranée qui fréquentent les côtes des Alpes Maritimes,
1826 et qui vivent dans le Golfe de Nice. In Histoire naturelle des principales productions de l'Europe méridionale. Paris, Levrault, vol.3:97-480

Rivas, L.R., A preliminary review of the western North Atlantic fishes of the family Scombridae.
1951 Bull.Mar.Sci.Gulf.Caribb., 1(3):209-30

Robins, C.R., et al., A list of common and scientific names of fishes from the United States and Canada.
1980 Spec.Publ.Am.Fish.Soc., (12):174 p., 4th ed.

Robins, J.P., Synopsis of biological data on bluefin tuna Thunnus thynnus maccoyii (Castelnau) 1872. FAO
1963 Fish.Rep., (6) vol.2:562-87

Rodríguez-Roda, J., Estudio de la bacoreta, Euthunnus alletteratus (Raf.), bonito, Sarda sarda (Bloch) y melva,
1966 Auxis thazard (Lac.), capturados por las almadrabas españolas. Invest.Pesq.Barc., 30:247-92

_____, Estudio de la edad y crecimiento del bonito, Sarda sarda (Bloch), de la costa sudatlántica de
1981 España. Invest.Pesq., Barc., 45(1):181-6

Rosa, H. Jr. (ed.), Proceedings of the World Scientific Meeting on the biology of tunas and related species. La
1963 Jolla, California, U.S.A., 2-14 July 1962. FAO Fish.Rep., (6) vol.1:100 p.

_____, Proceedings of the World Scientific Meeting on the biology of tunas and related species. Actes de
1963a la réunion scientifique mondiale sur la biologie du thon et des espèces voisines. Actas de la reunión científica mundial sobre biología del atún y especies afines. La Jolla, California, U.S.A., 2-14 July 1962. Vol. 2. Synopses. Exposés synoptique. Sinopsis. FAO Fish.Rep., (6) vol.2:101-975

_____, Proceedings of the World Scientific Meeting on the biology of tunas and related species. Actes de
1963b la réunion scientifique mondiale sur la biologie du thon et des espèces voisines. Actas de la reunión científica mundial sobre la biología del atún y especies afines. La Jolla, California, U.S.A., 2-14 July 1962. Vol. 3. Methodological and experience papers. Compte-rendus de méthodes et d'expériences. Trabajos metodológicos y de investigación. FAO Fish.Rep., (6) vol.3:977-1851

Roughley, T.C., Fish and fisheries of Australia. Sydney, Angus and Robertson, 343 p.
1953

Rüppell, E., Neue Wirbelthiere zu der Fauna von Abyssinien gehörig. Fische des Rothen Meeres. Frankfurt am
1835 Main, 148 p.

Sánchez, T.J. & R. Lam C., 1970 Algunas características físicas y químicas de las principales especies para consumo humano y sus rendimientos en productos pesqueros, en el Perú. Inf.Inst.Mar Perú, Callao, (33):92 p.

Schaefer, K.M., 1980 Synopsis of biological data on the chub mackerel, Scomber japonicus Houttuyn, 1782, in the Pacific Ocean. Spec.Rep.I-ATTC, (2):395-445

Schaefer, M.B., G.C. Broadhead & C.J. Orange, 1963 Synopsis on the biology of yellowfin tuna Thunnus (Neothunnus) albacares (Bonnaterre) 1788 (Pacific Ocean). FAO Fish.Rep., (6) vol.2:538-61

Schultz, L.P., 1960 Suborder Scombrina. Family Scombridae: tunas. Bull.U.S. Natl.Mus., 202(2):410-7

Serventy, D.L., 1941 The Australian tunas. Pam.Counc.Sci.Ind.Res.Aust., (104):48 p.

_____, 1948 Allothunnus fallai, a new genus and species of tuna from New Zealand. Rec.Canterbury Mus., N.Z., 5(3):131-5

_____, 1956 The southern bluefin tuna, Thunnus thynnus maccoyii (Castelnau), in Australian waters. Aust.J.Mar.Freshwat.Res., 7(1):1-43

_____, 1956a Additional observations on the biology of the northern bluefin tuna, Kishinoella tonggol (Bleeker) in Australia. Aust.J.Mar.Freshwat.Res., 7(1):44-63

Sette, O.E., 1943 Biology of the Atlantic mackerel (Scomber scombrus) of North America. Part 1. Early life history including growth, drift and mortality of the egg and larval populations. Fish.Bull.U.S.Fish Wildl.Serv., 50:149-237

_____, 1950 Biology of the Atlantic mackerel (Scomber scombrus) of North America. Part 2. Migrations and habits. Fish.Bull.U.S.Fish.Wildl.Serv., 51:251-358

Sharp, G.D., 1979 Areas of potentially successful exploitation of tunas in the Indian Ocean with emphasis on surface methods. Rome, FAO, IOFC/DEV/79/47:55 p.

Sharp, G.D. & A.E. Dizon (eds.), 1978 The physiological ecology of tunas. New York, Academic Press, 485 p.

Shaw, G., 1803 Pisces. In General Zoology, 4(2):187-632, G. Kearsley, London

Shimada, B.M., 1951 An annotated bibliography on the biology of Pacific tunas. Fish.Bull.U.S.Fish.Wildl.Serv., 52:1-58

Shingu, C., 1981 Ecology and stock of southern bluefin tuna. Translated by M.A. Hintze. Rep.Div.Fish.Oceanogr. CSIRO Cronulla, (131):79 p. Transl. of Fish.Stud.Japan Assoc.Fish.Resour.Prot., (31) (1978)

Shino, S.M., 1976 List of common names of fishes of the world, those prevailing among English-speaking nations. Sci.Rep.Shima Marineld., 4:262 p.

Sidwell, V.D., et al., 1974 Composition of the edible portion of raw (fresh or frozen) crustaceans, finfish and molluscs. I. Protein, fat, moisture, ash, carbohydrate, energy value, and cholesterol. Mar.Fish.Rev., 36(3): 21-35

Silas, E.G., 1963 Synopsis of biological data on double-lined mackerel Grammatorcynus bicarinatus (Quoy and Gaimard) (Indo-Pacific). FAO Fish.Rep., (6) vol.2:811-33

_____, 1963a Synopsis of biological data on dogtooth tuna Gymnosarda unicolor (Rüppell) 1838 (Indo-Pacific). FAO Fish.Rep., (6) vol.2:877-99

_____, 1963b Synopsis of biological data on oriental bonito Sarda orientalis (Temminck and Schlegel) 1842 (Indian Ocean). FAO Fish.Rep., (6) vol.2:834-61

_____, 1964 Aspects of the taxonomy and biology of the oriental bonito Sarda orientalis (Temminck and Schlegel). Symp.Ser.Mar.Biol.Assoc.India, 1(1):283-308

_____, 1964a Cybium croockewitii Bleeker (1850) and C. koreanum Kishinouye (1915) considered synonyms of Scomberomorus guttatus (Bloch and Schneider) with a redescription and annotated bibliobraphy of S. guttatus. Symp.Ser.Mar.Biol.Assoc.India, 1(1):309-42

_____, 1969 Exploratory fishing by R.V. NARUNA. CMFRI Bull., Cochin, (12):86 p.

Silas, E.G. & P.P. Pillai, 1982 Resources of tunas and related species and their fisheries in the Indian Ocean. CMFRI Bull., Cochin, (32):174 p.

Smith, J.L.B., 1961 The sea fishes of Southern Africa. Cape Town, Central News Agency, Ltd., 4th ed., pp. 510-80

Smith, M.M., 1975 Common and scientific names of the fishes of Southern Africa. Part. 1. Marine fishes. Spec.Publ.J.L.B. Smith Inst.Ichthyol., (14):178 p.

Smitt, F.A. (ed.), 1892 A history of Scandinavian fishes by B. Fries, C.U. Ekström & C. Sundevall. Stockholm, P.A. Norstedt and Söner, 2 parts:566 p. 2nd ed.rev.

Soldatov, V.K. & G.J. Lindberg, 1930 A review of the fishes of the seas of the Far East. Izv.Tikhookean.Nauchno-Promysl.Stn., 5:576 p. (in Russian) Transl. by National Marine Fisheries Service, Washington

South, J.F., 1845 Thunnus. In Encyclopedia Metropolitana, edited by Smedley, Rose and Rose. London, vol.25:620-2

Starks, E.C., 1922 The specific differences between the chub mackerels of the Atlantic and Pacific oceans. Copeia, (103):9-11

Steindachner, F. & L. Döderlein, 1884 Beiträge zur Kenntniss der Fische Japans. 3. Denkschr.Math.-Naturwiss.K. Akad.Wiss., 49:171-212

Storer, D.H., 1867 A history of the fishes of Massachusetts. Cambridge, Massachusetts, 287 p.

Sturm, M.G. de L., 1978 Aspects of the biology of Scomberomorus maculatus (Mitchill) in Trinidad. J.Fish Biol., 13:155-72

Swainson, W., 1839 The natural history of fishes, amphibians, and reptiles, or monocardian animals. Vol. 2. London, Longman, Orme, Brown, Green and Longman, (The cabinet cyclopaedia, vol. 120), 452 p.

Tamura, O. & Y. Kô, 1955 Studies on the differences between the types of Pneumatophorus japonicus (Houttuyn) and P. tapeinocephalus (Bleeker). 1. Bull.Fac.Fish.Nagasaki Univ., (3):107-12 (in Japanese with English abstract)

Temminck, C.J. & H. Schlegel, 1844 Pisces. In Fauna japonica, by P.F. von Siebold. Batavorum, Lugduni Batavorum, Pt. 3:73-112

Tham, A.K., 1950 The food and feeding relationships of the fishes of Singapore Straits. Fish.Publ.Colon.Off., Lond., 1(1):1-35

_____, 1953 A preliminary study of the physical, chemical and biological characteristics of Singapore Straits. Fish.Publ.Colon.Off., Lond., 1(4):1-65

Tiews, K., 1963 Synopsis of biological data on bluefin tuna Thunnus thynnus (Linnaeus) 1758 (Atlantic and Mediterranean). FAO Fish.Rep., (6) vol.2:422-81

Tomiyama, T., 1975 Fisheries in Japan; tuna. Tokyo, Japan Marine Products Photo Materials Association, 179 p.

Tomiyama, T. & T. Hibiya, 1976 Fisheries in Japan; skipjack and mackerel. Tokyo, Japan Marine Products Photo Materials Association, 161 p.

Tongyai, M.L. Prachaksilp, 1966 Background notes for Spanish mackerel (Scomberomorus spp.) from Thai waters, studies, 1954-1965. Scomberomorus Rep.Pap.Mar.Fish.Lab., Bangkok, (1):25 p.

_____, 1966a Spanish mackerels from M.V. DHANARAJATA (trawl during January, February and May, 1966). Scomberomorus Rep.Pap.Mar.Fish.Lab., Bangkok, (2):17 p.

_____, 1970 Plah in-see, Scomberomorus spp., of Thailand, 1967. In the Kuroshio - a Symposium on the Japan Current, edited by J.C. Marr, Honolulu, East-West Center Press, pp. 557-64

_____, 1971 An economic evaluation of the plah in-si (Pisces: Scombroidei) fishery. Bangkok, Marine Fisheries Laboratory, 17 p.

Tortonese, E., 1939 Risultati ittiologici del viaggio di circumnavigazione del globo della R.N. MAGENTA (1865-68). Boll.Mus.Zool.Anat.Comp.Univ.Torino, (Ser. 3), 47(100):177-421

Trent, L. & E.A. Anthony, 1979 Commercial and recreational fisheries for Spanish mackerel, Scomberomorus maculatus. In Proceedings of the Colloquium on the Spanish and King Mackerel Resources of the Gulf of Mexico, edited by E.L. Nakamura and H.R. Bullis, Jr. Publ.Gulf States Mar.Fish.Comm., (4):17-32

Trent, L., et al., 1981 Size and sex ratio of king mackerel, Scomberomorus cavalla, in the southeastern United States. NOAA Tech.Mem.NMFS/SEFC, (2):59 p.

Uchida, R.N., 1981 Synopsis of biological data on frigate tuna, Auxis thazard, and bullet tuna, A. rochei. NOAA Tech.Rep.NMFS Circ., (436):63 p. Issued also as FAO Fish.Synop., (124):63 p.

Valenciennes, A., 1843 Ichthyologie des îles Canaries, ou Histoire naturelle des poissons. In Histoire Naturelle des îles Canaries, by P.B. Webb and S. Berthelot. Paris, Bethune, vol.2:109 p.

Van der Elst, R., 1981 A guide to the common sea fishes of southern Africa. Capetown, C. Struik, 367 p.

Venkataraman, G., 1961 Studies on the food and feeding relationships of the inshore fishes off Calicut on the Malabar coast. Indian J.Fish., 7(2):275-305

Verany, J.B., 1846 Aggiunta al catalogo dei pesci della Liguria. Atti Sci.Ital.Genova, 8:492-4

Vijayaraghavan, P., 1955 Life-history and feeding habits of the spotted seer Scomberomorus guttatus (Bloch and Schneider). Indian J.Fish., 2(2):360-72

Vilela, H. & F. Frade, 1963 Exposé synoptique sur la biologie du thon à nageoires jaunes Neothunnus albacora (Lowe) 1839 (Atlantique oriental). FAO Fish.Rep., (6) vol.2:900-30

Wade, C.B., 1949 Notes on the Philippine frigate mackerels, family Thunnidae, genus Auxis. Fish.Bull.U.S.Fish Wildl.Serv., 51:229-40

Waldron, K.D., 1963 Synopsis of biological data on skipjack Katsuwonus pelamis (Linnaeus) 1758 (Pacific Ocean). FAO Fish.Rep., (6) vol.3:695-78

Walford, L.A., 1936 On the bonitos (Sarda) of the Pacific Ocean. Occas.Pap.Santa Barbara Mus.Nat.Hist., 4(3):8-10

_____, 1937 Marine game fishes of the Pacific coast from Alaska to the equator. Berkeley, University of California Press, 205 p.

Wang, Qizuo, 1982 Preliminary studies on the rational utilization of the resources of Japanese Spanish mackerel, Scomberomorus niphonius (Cuvier and Valenciennes). Mar.Fish., Shanghai, 4(2):51-5 (in Chinese)

Warashina, I & K. Hisada, 1972 Geographical distribution and body length composition of two tuna-like fishes, Gasterochisma melampus Richardson and Allothunnus fallai Serventy, taken by Japanese longline fishery. Bull.Far Seas Fish.Res.Lab., (6):51-75 (in Japanese with English summary)

Webb, B.F. & D.C. Wolfe, 1974 Commercial catches of slender tuna in Tasmanian waters. Aust.Fish., 33(8):5-7

Whitley, G.P., 1933 Studies in ichthyology, No. 7. Rec.Aust.Mus., 19(1):60-112

_____, 1935 Studies in ichthyology, No. 9. Rec.Aust.Mus., 19(4):215-50

_____, 1936 More ichthyological miscellanea. Mem.Queensl.Mus., 11(1):23-51

_____, 1937 The Middleton and Elizabeth Reefs, South Pacific Ocean. Fishes. Aust.Zool., 8(4):214-31

_____, 1944 New sharks and fishes from Western Australia. Aust.Zool., 10(3):252-73

_____, 1945 New sharks and fishes from Western Australia. Part. 2. Aust.Zool., 11(1):1-42

_____, 1947 New sharks and fishes from Western Australia. Part 3. Aust.Zool., 11(2):129-50

Whitley, G.P., 1964 Scombroid fishes of Australia and New Zealand. Symp.Ser.Mar.Biol.Assoc.India, 1(1):221-53

Williams, F., 1960 On Scomberomorus lineolatus (C.V.) 1831, from British East African waters (Pisces, Scombridae). Ann.Mag.Nat.Hist.(Ser. 13), 3(27):183-92

Williams, F., 1963 Synopsis of biological data on little tuna Euthynnus affinis (Cantor) 1850 (Indian Ocean). FAO Fish.Rep., (6) vol.2:167-79

_____, 1964 The scombroid fishes of East Africa. Symp.Ser.Mar.Biol.Assoc.India, 1(1):107-64

Wolfe, D.C. & B.F. Webb, 1975 Slender tuna (Allothunnus fallai Serventy): first record of bulk catches, Tasmania, 1974. Aust.J.Mar.Freshwat.Res., 26:213-21

Wollam, M.B., 1970 Description and distribution of larvae and early juveniles of king mackerel, Scomberomorus cavalla (Cuvier), and Spanish mackerel, Scomberomorus maculatus (Mitchill); (Pisces: Scombridae); in the western North Atlantic. Tech.Ser.Fla.Dep.Nat.Resour.Mar.Res.Lab., (61):35 p.

W., S.D. (perhaps S.D. Wood), 1836 The fishes (Pisces) of Britain, systematically arranged. Analyst, 5:204-15

Ximenes, M.O. Carneiro, M.F. de Menezes & A.A. Fonteles Filho, 1981 Idade e crescimiento da cavala, Scomberomorus cavalla (Cuvier) no Estado do Ceará (Brasil). Arq.Ciênc.Mar, Fortaleza, 18(1/2): 73-81

Yamanaka, H., et al., 1963 Synopsis of biological data on Kuromaguro Thunnus orientalis (Temminck and Schlegel) 1842 (Pacific Ocean). FAO Fish.Rep., (6) vol.2:180-217

Yasui, M., 1975 Some observations on the frigate mackerel which migrates into Japanese coastal waters. In Proceedings of the 1974 Tuna Research Conference, Shimizu, Japan, February, 4-6, 1975. Shimizu Fishery Agency, Far Seas Fisheries Research Laboratory, pp. 219-25 (in Japanese)

Yoshida, H.O., 1979 Synopsis of biological data on tunas of the genus Euthynnus. NOAA Tech.Rep.NMFS Circ., (429):57 p. Issued also as FAO Fish.Synop., (122):57 p.

_____, 1980 Synopsis of biological data on bonitos of the genus Sarda. NOAA Tech.Rep.NMFS Circ., (432):50 p. Issued also as FAO Fish.Synop., (118):50 p.

Yoshida, H.O. & E.L. Nakamura, 1965 Notes on the schooling behaviour, spawning, and morphology of Hawaiian frigate mackerels, Auxis thazard and Auxis rochei. Copeia, 1965(1):111-4

Yoshida, H.O. & T. Otsu, 1963 Synopsis of biological data on albacore Thunnus germo (Lacepède) 1800 (Pacific and Indian Oceans). FAO Fish.Rep., (6) vol.2:274-318

Yukinawa, S., 1970 Age and growth of southern bluefin determined by their scales. Bull.Far Seas Fish.Res.Lab., (3):229-57

Zabala, P.T. (comp.), 1982 A selected bibliobraphy on tuna fisheries in the South China Sea region. FAO, Colombo (Sri Lanka), IPTP/82/GEN/2:26 p.

Zavala-Camin, L.A., 1980 Habitos alimentares e distribuição dos atuns e afins (Osteichthyes - Teleostei) e suas relações ecológicas com outras espécies pelágicas das regiões sudeste e sul do Brasil. Dissertação apresentada ao Instituto de Biociências da Universidade de São Paulo, como parte dos requisitos para a obtenção do titulo de Doutor em Zoologia. São Paulo, 237 p. (MS)

# 5. INDEX OF SCIENTIFIC AND INTERNATIONAL FAO NAMES

## EXPLANATION OF THE SYSTEM

The index applies exclusively to Section 2.2 Information by Species

Type faces used:

***Italics*** : Valid scientific names (genera and species)
: Synonyms (preceeded by an asterisc)

**Roman** : International (FAO) species names

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ISBN 92-5-101381-0